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NUTRIGENE - PLANT BASED ( V E G A N ) REPORT



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# Summary of Results

## Nutrient Metabolism

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Vitamin A	BCMO1, rs11645428	GG	GG	Elevated	Meet the RDA for vitamin A daily.
Vitamin B <sub>12</sub>	FUT2, rs601338	GG or GA	GA	Elevated	Meet the RDA for vitamin B12 daily.
Vitamin C	GSTT1, rs2266633	Del	Ins	Typical	Meet the RDA for vitamin C daily.
Vitamin D	CYP2R1, rs10741657	Algorithm	GA	Elevated	Consume 1000 IU (25 mcg) vitamin D daily.
	GC, rs2282679		GG		
Vitamin E	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	TT	Elevated	Meet the RDA for folate daily.
Choline	MTHFD1, rs2236225	Algorithm	GG	Elevated	Meet the Adequate Intake (AI) level for choline daily.
	PEMT, rs12325817		CG		
Calcium	GC, rs7041	Algorithm	TG	Elevated	Consume 1200 mg of calcium daily.
	GC, rs4588		CA		
Iron Overload	SLC17A1, rs17342717	Algorithm	CC	Low	Follow the recommendations provided in the Low Iron Status section.
	HFE, rs1800562		GG		
	HFE, rs1799945		CC		
Low Iron Status	TMPRSS6, rs4820268	Algorithm	GA	Elevated	Meet the RDA for iron and consume sources of vitamin C with iron-rich foods.
	TFR2, rs7385804		CA		
	TF, rs3811647		AA		

## Food Intolerances and Sensitivities

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Lactose	MCM6, rs4988235	CC or CT	CT	Slightly Elevated	You have a slightly elevated risk of experiencing lactose intolerance symptoms after consuming lactose.
Gluten	HLA, rs2395182	Algorithm	GT	Medium	Medium risk for gluten intolerance.
	HLA, rs7775228		TT		
	HLA, rs2187668		CT		
	HLA, rs4639334		GG		
	HLA, rs7454108		TT		
Caffeine	ADORA2A, rs5751876	TT	CT	Typical	Follow the recommendations provided by the CYP1A2 gene section of this report.
			AA		

## Cardiometabolic Health

Dietary Component	Gene, rs Number	Risk/Response Variant	Your Variant	Your Risk/Response	Recommendations
Caffeine	CYP1A2, rs2472300	GA or AA	AA	Elevated	Limit caffeine intake to 200 mg/day.
Whole Grains	TCF7L2, rs12255372	TT or GT	GT	Elevated	Consume most grain products as whole grains.
Sodium	ACE, rs4343	GA or AA	AA	Elevated	Limit sodium intake to the Adequate Intake level.
Omega6- and Omega3- Fat	FADS1, rs174547	CC or CT	TT	Typical	Meet the RDA for omega6- LA fat and omega3- ALA fat.
Physical Activity	LIPC, rs1800588	TT or CT	CT	Enhanced	Aim for 150 to 300 min/week of cardio and at least 2 days/week of muscle-strengthening activities.



**2in5**  
People with Risk Variant

# 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.

\*Lietz G et al. Single nucleotide polymorphisms upstream from the b-carotene 15,15'-monooxygenase gene influence provitamin A conversion efficiency in female volunteers. Journal of Nutrition. 2012;142:1615-55.

## 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.

## Sources of Vitamin A

	Amount (mcg RAE)
Pumpkin, canned (2/1 cup)	1010
Carrots, cooked (2/1 cup)	650
Sweet potato, boiled without skin (2/1 medium)	600
Spinach, boiled (2/1 cup)	500
Butternut squash (2/1 cup)	410
Dried apricots (4/1 cup)	190
Cantaloupe (2/1 cup)	140

# 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. Vegetarians and vegans must take particular care to consume enough vitamin B<sub>12</sub>, as it is mainly found in meat, eggs, and dairy products. Therefore, it is more likely that a vegan or vegetarian will develop a vitamin B<sub>12</sub> deficiency. In addition, 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 plant-based foods are not a reliable source of vitamin B<sub>12</sub>, individuals with a genetic risk for vitamin B<sub>12</sub> deficiency who also follow a vegan diet may be at an even greater risk for deficiency.

\*Hazra A et al. Common variants of FUT2 are associated with plasma vitamin B12 levels. Nature Genetics. 2008 Oct;2:1160:1040.

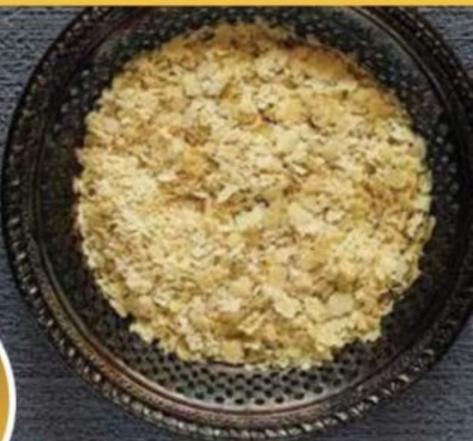
## FUT2

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 plant-based 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)
Fortified nutritional yeast (1 Tbsp)	3.9
Fortified plant-based beverage (1 cup)	2.2
Soy 'burger' patty (1)	1.7

\*Check your local health food or grocery store for fortified B12 products.



**4in5**  
People with Risk Variant

# Your Results

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

**Elevated**  
only when vitamin B<sub>12</sub> intake is low

# Recommendation

Since you possess an elevated risk variant for vitamin B<sub>12</sub> deficiency, you should aim to meet the RDA for vitamin B<sub>12</sub> of 2.4 mcg daily. This will help you to maintain a healthy nervous system and red blood cells, and prevent low energy levels. Plant sources of vitamin B<sub>12</sub> are not used by the body effectively, but plant-based milks, plant-based meats and breakfast cereals are fortified with vitamin B<sub>12</sub> which can help you to meet your needs. You should consult with your healthcare practitioner to monitor your vitamin B<sub>12</sub> blood levels. A supplement may be warranted.

Meet the RDA for vitamin B<sub>12</sub> daily.

# Your Results

Gene	Marker
BCMO1	rs11645428
Risk Variant	Your Variant
GG	GG

**Elevated**  
only when vitamin A intake is low

# Recommendation

Since you possess the GG variant of the BCMO1 gene, it is important for you to meet the RDA for vitamin A. Women should aim for 700mcg RAE/day and men should aim for 900 mcg RAE/day. Keep in mind that plant-based foods do not provide preformed sources of vitamin A. Therefore, a supplement may be warranted. Care should be taken to not exceed the tolerable upper intake level of 3000 mcg per day from dietary and/or supplement sources. Meeting your recommendations for vitamin A will help to support healthy immunity, vision, and reproductive health. It will also act as an antioxidant when consumed in the form of beta-carotene (plant-sources).

Meet the RDA for vitamin A daily.



1 in 150

People with Risk Variant(s)

## Your Results

Genes	Markers
SLC17A1 HFE HFE	rs17342717 rs1800562 rs1799945
Risk Variants	Your Variants
Algorithm	CC GG CC

Low

## Recommendation

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

Follow the recommendations provided in the Low Iron Status section.

# Iron Overload

Hemochromatosis is a condition where the body absorbs too much iron (i.e. iron "overload") and can result in liver disease, arthritis and heart conditions. If you have a high risk for iron overload it is important to monitor your iron intake and blood markers of iron status such as ferritin, hepcidin or transferrin saturation. There are two main types of dietary iron: heme and non-heme iron. Non-heme iron is the only type 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. The bioavailability of some food sources of non-heme iron, like spinach, is increased when cooked. Hereditary hemochromatosis is an iron overload condition that is linked to variations in the HFE or SLC17A1 genes.\*

\*Allen KJ et al. Iron-overload-related disease in HFE hereditary hemochromatosis. *New England Journal of Medicine*. 30:358-221;2008.  
Pichler I et al. Identification of a common variant in the 11-HFE gene implicated in the physiological regulation of serum iron levels. *Human Molecular Genetics*. 40-15:1232;2011.

## 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.

# 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 more common in vegans and is determined by measuring certain blood markers such as ferritin, hepcidin or transferrin. Iron is found in food in two forms; heme and non-heme iron. Heme-iron, derived from animal products is well absorbed. Non-heme iron, which is the iron in plants, is less well absorbed. Because vegan diets only contain non-heme iron, vegans should be particularly aware of foods that are high in iron and ways to promote iron absorption, such as using cast iron pans, and adding a vitamin C source to meals. Recommendations for iron for vegans and vegetarians may be as much as 1.8 times higher than for non-vegetarians. 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.\*

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

## TMPRSS6, TFR2 & TF

The TMPRSS6 gene codes for the protein matriptase2-, 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)
White beans, canned (1 cup)	8.0
Soybeans, cooked (4/3 cup)	6.5
Pumpkin seeds (2 Tbsp)	5.2
Lentils, cooked (4/3 cup)	4.1
Spinach, boiled (2/1 cup)	3.4
Tempeh, cooked (4/3 cup)	3.2
Tofu, firm (1/2 cup)	3.0
Tahini (2 Tbsp)	2.7
Chickpeas (4/3 cup)	2.4
Almonds (4/1 cup)	1.5



2 in 5

People with Risk Variant(s)

## Your Results

Genes	Markers
TMPRSS6 TFR2 TF	rs4820268 rs7385804 rs3811647
Risk Variants	Your Variants
Algorithm	GA CA AA

Elevated

only when iron intake is low

## Recommendation

You are at an increased risk for low iron status. To minimize your risk for low iron, meet the RDA for iron and consume food sources of vitamin C with non-heme iron-containing foods to increase iron absorption. Combinations, such as beans and tomato sauce or stir-fried tofu and broccoli, result in generous levels of iron absorption. Keep in mind that some food sources of non-heme iron, like spinach, are better to consume in cooked form to improve the bioavailability of iron. Both calcium in foods and supplements and tannins (found in tea and coffee) reduce iron absorption, and should therefore be consumed several hours before a meal that is high in iron. Men aged 19 years and older and women over 50 should aim for 8 mg/day. Women 50-19 years old should aim for 18 mg/day.

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



**1 in 2**  
People with Risk Variant

## Your Results

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

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 omega6- LA or your balance of omega6- LA to omega3- ALA intake. Meet the guidelines for healthy adults. Individuals should aim to consume between %10-5 of energy from omega6- LA and between %1.2-0.6 of energy from omega3- ALA. Limit intakes of omega6- 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 omega3- ALA. Other foods rich in omega3- ALA include flax and chia seeds.

Meet the RDA for omega6- LA fat and omega3- ALA fat.

# Omega6- and Omega3- Fat

Higher consumption of polyunsaturated fats (PUFAs) is associated with reduced risk of cardiovascular disease. PUFAs include both omega6- fat, such as linoleic acid (LA), and omega3- fat, such as alpha-linolenic acid (ALA). Since our bodies cannot make omega6- LA and omega3- ALA, these essential fats must be obtained from our diets. However, consuming too much omega6- LA and too little omega3- 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 omega6- LA intake is high,\* or when the ratio of omega6- LA to omega3- ALA is too high.\*\*

\*Lu Y et al. Dietary n3- and n6- polyunsaturated fatty acid intake interacts with FADS1 genetic variation to affect total and HDL-cholesterol concentrations in the Doetinchem Cohort Study. *American Journal of Clinical Nutrition*. 65-92:258, 2010.  
 Dumont J et al. Dietary linoleic acid interacts with FADS1 genetic variability to modulate HDL-cholesterol and obesity-related traits. *Clinical Nutrition*. 1689-37:1683, 2018.  
 \*\*Helisrand S et al. Intake levels of dietary long-chain PUFAs modify the association between genetic variation in FADS and LDL-C. *Journal of Lipid Research*. 1189-1183 :53 ,2012.

## FADS1

The FADS1 gene directs the production of an enzyme called fatty acid desaturase 1. This enzyme converts omega6- LA and omega3- 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 omega6- LA is high. Among those with the CC or CT variant, increasing the proportion of dietary omega3- ALA to omega6- LA promotes higher levels of HDL cholesterol.

## Sources of Omega6- and Omega3- Fats

	Omega3- ALA (g)	Omega6- 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 (4/1 cup)	0.9	11
Edamame (2/1 cup)*	0.3	1.5
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

\*Helps achieve a higher balance of omega3- ALA to omega6- 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.\*

\*Graup et al. The 250-G>A promoter variant in hepatic lipase associates with elevated fasting serum high-density lipoprotein cholesterol modulated by interaction with physical activity in a study of 16,156 Danish subjects. *Journal of Clinical Endocrinology and Metabolism*. 2299-93:2294, 2008.  
 Ahmad et al. Physical Activity Modifies the Effect of LPL, LIPC, and CETP Polymorphisms on HDL-C Levels and the Risk of Myocardial Infarction in Women of European Ancestry. *Circulation: Cardiovascular Genetics*. 804:74, 2011.

## 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



**1 in 3**  
People with Response Variant

## Your Results

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

**Enhanced**  
when physical activity is high

## Recommendation

Since you possess the CT or TT variant of the LIPC gene, you have an enhanced HDL cholesterol-raising response from physical activity. Engage in 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. This will ensure that you reap the benefits of physical activity not only for your cholesterol levels, but also body composition, weight management, mental health, blood pressure, bone health, blood sugar, and many other health-related factors. 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.



**1 in 4**  
People with Risk Variant

# 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.\*\*

\*Eny KM et al. Genetic variant in the glucose transporter type 2 is associated with higher intakes of sugars in two distinct populations. *Physiol Genomics*. 60-355: (3)33;2008.  
\*\*Kulkarni GV et al. Association of GLUT2 and TAS1R2 genotypes with risk for dental caries. *Caries Research*. 25-47:219 ;2013

## Sources of High Sugar Foods

	Amount (g)
Cola (1 can)	36
Citrus juice, frozen, diluted (1 cup)	32
Vegan caramels (40g)	26
Vegan chocolate (50g)	26
Maple syrup (2 Tbsp)	24
Vegan caramel-coated popcorn (1 cup)	20
Red licorice (3 pieces)	15
Popsicle (75g)	10
Jam (1 Tbsp)	10

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

# 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.\*

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

## MC4R

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

Replace these foods...	with these foods..
Potato chips and a plant-based dip	Whole wheat pita with hummus or other plant-based dip
Muffin	Whole wheat English muffin with peanut butter
Dairy-free ice cream with toppings	Soy/plant-based yogurt with fresh berries
Trail mix with added oils or sweets	Fibre-rich cereal with plant-based milk alternative
'Veggie' chips	Fresh vegetables with with plant-based dip
Pasta salad	Mixed salad topped with chickpeas
Potato chips	Natural popcorn
Vegan pizza slice	Half a veggie sandwich with hummus



**2 in 5**  
People with Risk Variant

# Your Results

Gene	Marker
MC4R	rs17782313
Risk Variant	Your Variant
CC or CT	TT

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.

# Your Results

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

Elevated

## Recommendation

Since you possess the CT or TT variant of the GLUT2 gene, you are at an increased risk of over-consuming sugar. Be mindful of this tendency to consume sweet foods and beverages and aim to keep your intake of added sugar below %5 of your total daily energy intake. A high intake of added sugar is linked to overweight & obesity, cardiometabolic disease and dental caries risk.

You have a high preference for sugar.



## Your Results

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

Ultra

## Implications

Since you possess the CC 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 genetic advantage to excel in power sports.

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



## ACTN3

There are two types of muscle fibres: slow twitch and fast twitch. Fast twitch muscle fibres contract with greater speed and force, which are needed for short bursts of intense activities including sprinting or lifting heavy objects. Slow twitch fibres contract for longer periods and at lower intensities and are used in activities such as walking, slow running or easy cycling. The ACTN3 gene encodes the alpha-actinin3- protein, which is only expressed in fast twitch muscle fibres. Therefore, certain variations in this gene can be beneficial for exercises or activities requiring strength and power. In particular, individuals with the CC variant of ACTN3 are more likely to excel at strength-based activities. Those with the TC variant have a slightly enhanced power and strength potential.\*

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

# Endurance

Endurance 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.\*\*

\*Ahmetov I et al. Genome-wide association study identifies three novel genetic markers associated with elite endurance performance. Biol Sport. 9-3;(1)32;2015. doi:20831862.1124568/10.5604.  
Santiago C et al. Trp64Arg polymorphism in ADRB3 gene is associated with elite endurance performance. British Journal of Sports Medicine. 9-45:147;2011.  
\*\*Zarebska A et al. The GSTP1 c.313A>G polymorphism modulates the cardiorespiratory response to aerobic training. Biol Sport. 266-31;261;2014.  
He et al. NRF2 genotype improves endurance capacity in response to training. Int J Sport Med. 2007; 721-28;717.  
Stefan et al. Genetic Variations in PPARδ and PPARγ1α Determine Mitochondrial Function and Change in Aerobic Lifestyle Intervention. J Clin Endocrinol Metab. 1833-1827 :92 ;2007.



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

NFIA-AS2, ADRB3, NRF2, GSTP1 and PGC1a are all involved in physiological processes that impact your endurance abilities. Individuals with the CC variant in the NFIA-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 power houses 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
NFIA-AS2	rs1572312
ADRB3	rs4994
NRF2	rs12594956
GSTP1	rs1695
PGC1a	rs8192678

Response Variants	Your Variants
Algorithm	CC TT CA AG AA

Typical

## Implications

Based on your DNA, your endurance potential is typical. You may need to increase your training to a greater extent than an individual with a genetic advantage to achieve the same level of cardiovascular fitness. Aim to get at least 150 to 300 minutes of moderate-intensity exercise per week. This can be met through 30 to 60 minutes of moderate-intensity aerobic exercise five days per week, such as brisk walking or moderate intensity cycling.

Your endurance potential is typical.





# 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 phosphorous 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.\*

\*Zheng et al. WNT16 influences bone mineral density, cortical bone thickness, bone strength, and osteoporotic fracture risk. PLOS Genetics. 2012;8: e1002745.

## 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/trekking	Tennis
Jogging	Team Sports

### Types of Resistance Activities

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

# 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.\*

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

## COL5A1

The COL5A1 gene directs the body to produce a protein called collagen alpha1-(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



# Your Results

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



# Implications

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



# Your Results

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



# 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.

