# Comprehensive DNA Health Report

## Welcome to the future of health and human potential

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| Name: | Sample Patient Report |
| DOB: | 7/9/82 |
| Barcode: | DC0001481 |
| Date: | 10/26/22 |

# MACRONUTRIENT METABOLISM

## APOE Status: 3/3

**You are a Farmer**

ApoE-e4 ApoE-e3 ApoE-e2

Apolipoprotein E (ApoE) is a lipid-binding protein that transports triglycerides and cholesterol in multiple tissues, including the brain. The e2 and e3 alleles are most common in agricultural communities, while the e4 allele is common in hunter-gatherer communities.

- ApoE 3/3 is the most common ApoE genotype found in agricultural communities and has numerous benefits
- Extended cognitive fitness and enhanced expression of anti-aging sirtuins
- Improved HDL and LDL profile
- Improved ability to repair synapses and neural protection
- Higher viral protection
- Higher response to plant bioactive compounds
- In the brain, e2 and e3 accumulate in neurons 2 to 4-fold higher than e4

## Protein Requirements

Protein — AVERAGE INCREASED HIGH

Traditional protein intake ranges based on latitude from less than 18% of total calories to approximately 35% in the far northern climates. Recommended protein intake varies based on weight and exercise intensity.

- Genetically, your requirements fall on the average side of the spectrum, approximately 18-20% of total caloric intake

## Carbohydrate Requirements

Carbohydrates — VERY LOW LOW AVERAGE

Your carbohydrate intake range is based on the latitude of your ancestors and whether a hunter-gatherer diet or modern agricultural diet made a larger imprint on your genes.

- Your genotype combination is associated with improved carbohydrate metabolism, allowing 40% to 55% of total calories from carbohydrates if desired
- For a 2,000 calorie diet, this comes to 200 to 275 grams of carbohydrates per day

## Carbohydrate Requirements

Refined Carbohydrates — LESS RISK SLIGHT RISK HIGH RISK

The differences between responses in individuals to refined carbohydrates have been linked to a genetic adaptation occurring during the agricultural age.

- Your genotype is associated with an adaptation for lowering the sensitivity to refined carbohydrates

## Fat Requirements

Omega-3's


The NIH has set the recommended intake of omega-3's from 1.1 to 1.6 grams per day from a combination of ALA, EPA and DHA. Omega-3 fatty acids are essential for brain, eye, and cardiovascular health.

- Your genotype combinations are associated with a higher requirement of EPA and DHA
- ApoE e2 and e3 carriers can benefit from non-phospholipid fish oil intake, however, e4 carriers should use phospholipid-based EPA and DHA as found in fish and fish roe
- For ApoE e4 carriers, fish oil supplements do not appear as effective as phospholipid-based EPA and DHA as found in fish and fish roe
- E4 carriers may have impaired transport of free DHA and require phospholipids for successful transport

## Fat Requirements

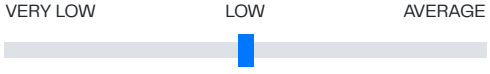
Monounsaturated and Polyunsaturated


Traditional total fat intake ranges based on latitude, with as low at 25% consumed in countries closer to the equator, and up to 55% of total calories from fat being consumed in northern latitudes.

- Genetic testing can show which fats to focus on, but total fat will range based on your climate and health goals
- Your genoypes are associated with a higher emphasis on monounsaturated and polyunsaturated fats from olive oil, avocados, poultry, nuts and seeds

## Fat Requirements

Saturated Fat (Red Meat)

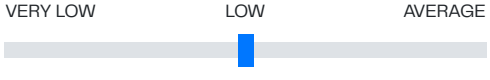



The 2020 Dietary Guidelines in the U.S. recommends limiting calories from saturated fats to less than 10% of the total calories you eat and drink each day. That's about 200 calories for a 2,000 calorie diet. Traditionally, saturated fat intake from animal foods ranged based on the season and the geographical location, with higher latitudes and more mountainous regions consuming more.

- Based on your genotype combinations, you should aim to get less saturated fat in your diet from red meat
- Limit your red meat consumption to twice a week

## Fat Requirements

Saturated Fat (Dairy)

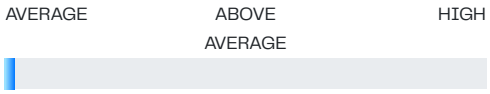



The 2020 Dietary Guidelines in the U.S. recommends limiting calories from saturated fats to less than 10% of the total calories you eat and drink each day. That's 200 calories for a 2,000 calorie diet.

- Your genotype combinations are associated with benefiting from getting less than 22 grams of saturated fat in your diet, especially from dairy

## Micronutrient Requirements

B1 (Thiamine)

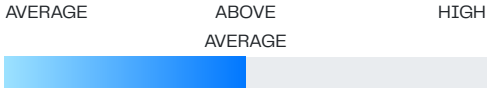



The recommended daily allowance (RDA) for thiamine is 1.2mg. Thiamine requirements are analyzed based on ethanol metabolism, however, chronic intake of alcohol depletes thiamine.

- Your genotype is associated with an average need for B1

## Micronutrient Requirements

B2 (Riboflavin)




The recommended daily allowance (RDA) for riboflavin is 1.3mg. Riboflavin is used as a co-factor for numerous reactions associated with protein, fat, and carbohydrate metabolism. Riboflavin requirements are analyzed based on MTHFR gene function.

- Your genotype is associated with a higher than average need for B2
- B2 is high in liver (2.8mg), lamb (0.4mg), salmon (0.8mg), yogurt (0.6mg) and oyster mushrooms (0.3mg)

## Micronutrient Requirements

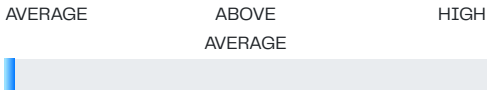
B3 (Niacin)


The recommended daily allowance (RDA) for niacin is 16mg. Niacin targets genes associated with cardiovascular and skin health, while also balancing methylation levels.

- Your genotype is associated with a higher sensitivity to low niacin intake
- Niacin in high in yellowfin tuna (37.5mg), canned tuna (21.9mg), wild salmon (17mg), ground turkey (20mg), chicken breast (16mg), liver (14.2mg), skirt steak (9.5mg), white button mushrooms (6.8mg), and brown rice (5.2mg)

## Micronutrient Requirements

B6 (Pyridoxine)




The recommended daily allowance (RDA) for B6 is 1.7mg. B6 deficiency can manifest as anorexia, irritability, anxiety, depression, muscle pain, bad PMS/low progesterone, nausea, seizures, migraines, dermatitis, age related macular degeneration (with low folate and B12) and lethargy.

- Your genotype is associated with an average need for B6

## Micronutrient Requirements

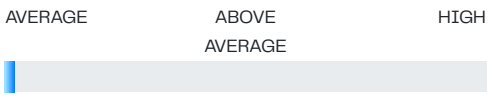
B9 (Folate)


The recommended daily allowance (RDA) for folate is 400mcg. Folate is one of the – if not most – influential nutrigenomic micronutrient. It has a powerful influence on genes related to pregnancy, homocysteine, and cancer prevention.

- Your genotype is associated with a higher than average need for folate
- Folate is depleted by proton pump inhibitors, oral contraceptives, NSAIDs, anticonvulsants, antivirals, antibiotics, and antacids
- Folate is high in liver (3 oz., 215mg), collard greens (1 cup cooked, 177mcg), beets (1 cup raw, 148mcg), black-eyed peas (1/2 cup, 105mg), raw spinach (1 cup 58mg), asparagus (4 spears, 89mg), hummus (1/2 cup, 83mcg), broccoli (1/2 cup cooked, 52mg), romaine lettuce (1 cup, 64mg), strawberries (1 cup, 40mcg), orange (1 whole, 39mcg), sprouted lentils (1/2 cup, 38mcg), and parsley (1 sprig, 15.2mg)

## Micronutrient Requirements

B12 (Cobalamin)




The recommended daily allowance (RDA) for B12 is 2.4mcg. B12 influences genes related to homocysteine, brain health, pregnancy, and energy. B12 requirements are based on serum levels associated with the FUT2 gene.

- Your genotype is associated with an average requirement for B12

## Micronutrient Requirements

Boron


The recommended daily allowance (RDA) for boron has not been set, but 1–3mg is considered adequate. Boron is connected to bone health, hormone health and healthy SAMe levels for brain health. Men with low testosterone and women with osteoporosis or osteopenia will benefit from more boron.

- Your genotype is associated with a higher sensitivity to low boron intake
- Boron is highest in prunes (10 prunes, 1.18mg) avocados (1/2 cup, 1.07mg), raisins (1.5 oz, 0.95mg), peach (1 whole, .80mg), apple (1 whole, .66mg), pear (1 whole .50mg), and peanut butter (2 tablespoons, 0.46mg)

## Micronutrient Requirements

Choline & Betaine


The recommended daily allowance (RDA) for choline is 550mg, while betaine hasn't been set. The more betaine you consume, the less choline you require. Choline is crucial for pregnancy, lowers anxiety, prevents fatty liver, assists detoxification, and improves memory.

- Your genotype is associated with a higher than average need for choline and betaine
- Choline is depleted by nighttime pain relievers, antihistamines, sleep aids, antidepressants, incontinence drugs and narcotic pain relievers
- Intense endurance exercise depletes choline levels, and increasing phosphatidylcholine has been found to improve exercise capacity during high-intensity cycling and running, as well as reduce muscle soreness
- Choline is highest in liver (3 oz., 356mg), pastured eggs (2 eggs, 294mg), beef round (6 oz., 234mg), heart (3 oz., 194mg), chicken (6 oz., 144mg), wild cod (6 oz., 142mg), bacon (3.5 oz., 125mg), and edamame (1/2 cup, 107mg)
- Betaine is highest in spinach (3.5 oz., 645mg), shrimp (3.5 oz., 218mg), beets (3.5 oz., 200mg) and whole grain sourdough wheat bread (2 slices, 201mg)

## Micronutrient Requirements

Vitamin A


The recommended daily allowance (RDA) for vitamin A is 900 mcg for men and 700 mcg per day for women. Vitamin A assists digestive lining repair, oral health, eye health, iron mobilization, mitochondria health, skin health, healthy lung function, and increased immunity.

- Your genotype is associated with a 32% lower conversion rate of beta-carotene to vitamin A, making it important to include more animal-based vitamin A to hit your daily target
- Vitamin A is high in liver (3 oz., 6,600mcg), pastured eggs (1 egg, 75mcg), cod liver oil (378mcg), wild salmon oil (206mcg), pickled herring (219mcg) and sockeye salmon (118mcg)

## Micronutrient Requirements

Vitamin D


The recommended daily allowance (RDA) for vitamin D is 20mcg. Vitamin D has a wide role in immune function, bone health, cardiovasular health and cancer prevention.

- Your genotype is associated with below average circulating levels of vitamin D
- Vitamin D is depleted by obesity, pesticides, a high fructose intake, anticonvulsants, barbiturates, benzodiazepines, calcium channel blockers, corticosteroids, antidepressants, and bronchodilators
- Vitamin D is highest in sockeye salmon (6 oz., 28.4mcg), cod liver oil (1 tsp., 11mcg), canned tuna (1 can, 6.7mcg), wild herring (3 oz., 5.4mcg), sardines (1 can, 4mcg)

## Micronutrient Requirements

Vitamin C


The recommended daily allowance (RDA) for vitamin C is 90mg, however, the amount consumed in the Paleolithic era was 400mg per day. Studies show the best results occur with over 500mg per day. Extensive research shows that adequate vitamin C reduces the risk of cancer, heart disease, colds, flu, cataracts, hypertension and even depression.

- Your genotype is associated with average serum vitamin C levels

## Micronutrient Requirements

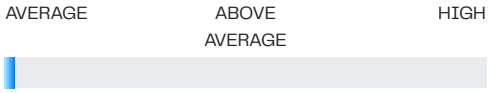
Vitamin E


The recommended daily allowance (RDA) for vitamin E is 15mg. Vitamin E is important for antioxidant protection, skin health, fertility, brain health, and cardiovascular health.

- Your genotype is associated with a higher sensitivity to low vitamin E intake
- Vitamin E is highest in sunflower seeds (1 oz., 7.4mg), almonds (1 oz. 7.3mg), avocado (1 whole, 4.2mg), spinach (1 cup cooked, 3.7mg), butternut squash soup (1 cup, 2.6mg) and olive oil (1 tablespoon, 1.9mg)

## Micronutrient Requirements

Vitamin K2

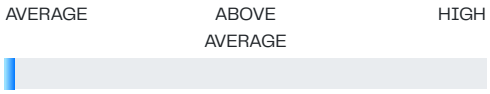



The recommended daily allowance (RDA) for vitamin K2 has not been established, but based on amounts found in food and research, 60–70mcg of MK-4 and MK-7 is a good target. MK-4 targets sex hormones, the brain, possesses anti-cancer and anti-inflammatory activity, and also supports bone health. MK-7 is considered better for reducing arterial calcification, increasing bone density, anti-cancer, improving salivary buffering (minimizes the de-mineralization of enamel and enhances its re-mineralization), and increasing cardiac output (12% increase) in athletes.

- Your genotype is associated with an average need for K2

## Micronutrient Requirements

Magnesium

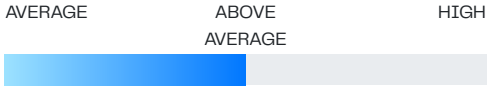



The recommended daily allowance (RDA) for magnesium is 400mg, however, higher amounts may be required for certain individuals, stress levels and athletes. Magnesium levels vary drastically based on the soil, and therefore in the food. Magnesium is involved in 300 biochemical reactions, and deficiency has widespread effects on every aspect of health. The most common symptoms of low magnesium includes calf cramps at night, headaches, arrhythmia, calcification, and muscle fatigue.

- Your genotype is associated with an average need for magnesium

## Micronutrient Requirements

Manganese




The recommended daily allowance (RDA) for manganese has not been set, however, 1.8 to 2.3mg per day is considered adequate. Manganese has a special role in protecting the mitocondria of the cells against toxicity through superoxide dismutase. Manganese is crucial for heart health, blood sugar, male fertility, bone health and protecting the brain against glutamate toxicity.

- Your genotype is associated with a higher sensitivity to low manganese intake
- Manganese is highest in mussels (3 oz., 5.8mg), wild blueberries (1/2 cup, 2.87mg), hazelnuts (2 tablespoons, 1.6mg), pecans (2 tablespoons, 1.1mg), oysters (3 oz., 1mg), clams (3 oz., 0.9mg), hummus (1/2 cup, 0.9mg), spinach (1/2 cup cooked, 0.8mg), cultivated blueberries (1/2 cup, .33mg)

## Micronutrient Requirements

Lithium

AVERAGE | ABOVE AVERAGE | HIGH



The recommended daily allowance (RDA) for lithium has not been set, with normal intake ranging from 250mcg to 3mg. Studies found an association between higher levels of lithium in local water and "beneficial clinical, behavioral, legal and medical outcomes." In the context of your genetic analysis, we are looking at lithium requirements in regards to B12 transportation.

- Your genotype is associated with an average need for lithium

## Micronutrient Requirements

Selenium

AVERAGE | ABOVE AVERAGE | HIGH



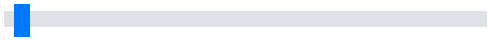
The recommended daily allowance (RDA) for selenium is 55mcg. Selenium levels in plant and animal foods vary drastically based on the soil. Selenium is a crucial mineral linked to numerous genes involved in glutathione (the master antioxidant), detoxification, immunity, thyroid health, skin health, and cancer prevention.

- Your genotype is associated with an average need for selenium

## Fiber Requirements

Prebiotic Fiber

AVERAGE NEED | INCREASED | HIGH



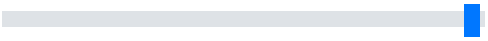
The recommended amount of fiber is up to 25 grams per day for women and up to 38 grams per day for men.

- Your genotypes are associated with an average requirement for prebiotic fiber

## Phytonutrient Requirements

Lutein and Zeaxanthin

AVERAGE NEED | INCREASED | HIGH



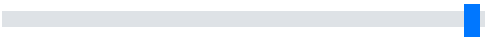
A recommended daily intake of lutein and zeaxanthin hasn't been established. Lutein and zeaxanthin can help protect your eyes from harmful high-energy light waves like UV sunlight.

- Your genotype is associated with an increased need for foods high in lutein and zeaxanthin to support eye health
- Around 700 carotenoids have been discovered and only lutein and zeaxanthin are found in the eye
- American adults typically consume 1–3 mg/day of lutein and zeaxanthin, the Spanish consume 3.5 mg/day, the Germans consume 5.33 mg/day, and older Australians consume 0.9mg per day
- For reducing the risk of eye disorders, the estimated target is 6mg or more of lutein and zeaxanthin daily
- The foods highest in lutein and zeaxanthin include cooked spinach (1/2 cup, 12.64 mg lutein), raw spinach (1/2 cup, 6.6mg lutein), cooked kale (1/2 cup, 8.88mg lutein), egg yolks (1 egg, 237mcg lutein and 216mcg zeaxanthin), and orange peppers (208mcg lutein and 1665mcg zeaxanthin)

## Phytonutrient Requirements

Polyphenols

AVERAGE NEED | INCREASED | HIGH



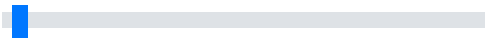
Research strongly suggests that long term consumption of diets rich in plant polyphenols offer protection against development of cancers, cardiovascular diseases, diabetes, osteoporosis and neurodegenerative diseases.

- Your genotype is associated with a fast metabolism of polyphenols, which means you need a higher intake of polyphenols to obtain the same benefit of other slower genotypes that require less
- Polyphenols found in green tea (also in Kombucha), coffee, chocolate and all berries provide the most benefit of a higher intake

## Phytonutrient Requirements

Cinnamon

AVERAGE NEED | INCREASED | HIGH



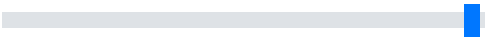
Cinnamon lowers blood glucose usually without causing hypoglycemia and increases satiety.

- Your genotype is associated with an average need for cinnamon to control blood sugar

## Phytonutrient Requirements

Cruciferous Vegetables

AVERAGE NEED | INCREASED | HIGH



Isothiocyanates from cruciferous vegetables are known for their anti-cancer activity. Certain genotypes require higher levels of this anti-cancer activity.

- Your genotype combinations are associated with a higher requirement of cruciferous vegetables
- Cruciferous vegetables include broccoli, Brussels sprouts, cabbage, cauliflower, radishes, turnips, Bok choy, and watercress
- Aim for 1-2 cups of cruciferous vegetables per day

## Phytonutrient Requirements

Apigenin (Males)

AVERAGE NEED | INCREASED | HIGH

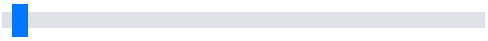
Apigenin is a flavonoid that possess anti-inflammatory, antioxidant and anti-cancer properties. Certain genotypes require higher levels for prostate health.

- Your genotype is associated with a higher than average need for apigenin for prostate health
- Apigenin is highest in dried parsley, celery and chamomile tea

## Lactose Tolerance

Lactose Tolerance

TOLERANT | ABOVE AVERAGE | HIGH



Lactose is the major carbohydrate in milk. The arrival of farming in Europe around 8,500 years ago necessitated adaptation to new environments, pathogens, diets, and social organizations. One of the best examples of genetic dietary changes to this is the lactase enzyme in northern Europeans that only dates to the last 4,000 years.

- Your LCT genotype is associated with lactose tolerance
- The ability to digest lactose is much more common in people of European ancestry
- Approximately 32 percent of the world's population is lactose tolerant
- Since this gene only looks at lactose, sensitivities to dairy can still exist

## Caffeine Metabolism

Caffeine Metabolism

SLOW | INTERMEDIATE | FAST

Variants in the CYP1A2 gene determine the rate at which you metabolize caffeine.

- You are an intermediate metabolizer of caffeine, meaning your body breaks down caffeine at an intermediate rate, giving you an average sensitivity to the effects of increased consumption


TOXIN SENSITIVITY

## Toxin Sensitivity

Mycotoxins


Mycotoxins are toxic compounds that are naturally produced by certain types of fungi. Research suggests that mycotoxins can decrease the formation of glutathione due to decreased gene expression of the enzymes needed to form glutathione.

- Your genotype is associated with lower glutathione levels which may cause glutathione depletion to occur at a faster rate and decrease mycotoxin detoxification
- The highest exposure to mycotoxins can be in foods grown or stored in damp conditions
- This may include grains, nuts, corn, coffee, wine, beer, grape juice, sorghum, rice, dried beans, apples, pulses, cacao products, and spices
- Boosting glutathione can be accomplished with selenium, glycine, cysteine, alpha lipoic acid, vitamin C, and cruciferous vegetables

## Toxin Sensitivity

Xenoestrogens


Xenoestrogens are synthetic hormone disruptors found in plastics and pesticides.

- Your genotype is associated with a faster metabolism of xenoestrogens, which may assist lowering the circulation and toxic activity

## Toxin Sensitivity

Occupational Toxins


Workers exposed to certain chemicals over a long period in the metalworking, petroleum, agricultural industries and in glass factories are at increased risk for occupational skin cancers.

- Your genotypes are associated with an increased sensitivity to these toxins
- Focus on zinc, selenium, niacin, and vitamin C to improve DNA protection for skin health
- Ellagic acid, lutein, zeaxanthin, cocoa polyphenols, chaga tea, green tea and citrus have all been found to help protect against skin damage and cancerous growth

## Toxin Sensitivity

Ethanol


ALDH2 encodes for aldehyde dehydrogenase, and variants can affect the levels of acetaldehyde and therefore the carcinogenic effect of alcohol.

- Your genotype is not associated with a higher risk of alcohol-related adverse reactions including flushing, palpitation, nausea, headache, drowsiness, breathlessness, and general discomfort

## Toxin Sensitivity

Benzo(a)pyrene


Benzo(a)pyrene is a carcinogenic compound produced from the burning of wood or trash, tobacco smoke, asphalt, coal, diesel exhaust, charred meat, and gas cooking.

- Your genotype combinations are associated with decreased detoxification of benzo(a)pyrene
- It is recommended to increase your intake of cruciferous vegetables, vitamin C, vitamin E, vitamin A, resveratrol, curcumin, green tea, and white tea to protect and detoxify benzo(a)pyrene

## Toxin Sensitivity

Aromatic Amines


Aromatic amines are found in cigarettes, rubber factories, hair dyes that contain 4–aminobiphenyl, and meat cooked at high temperatures.

- Your genotype combinations are associated with a poor detoxification ability of aromatic amines
- It is recommended to increase cruciferous vegetable intake, carotenoids, and vitamin C, and use marinades for meat with barbecuing

## Toxin Sensitivity

Aspartame


Aspartame is an artificial sweetener that has been linked to behavioral, neurological and cognitive problems, increased blood sugar, thyroid issues, and certain types of cancer.

- Your genotype combinations may lower the sensitivity to aspartame
- Possible neurophysiological symptoms include learning problems, headache, seizure, migraines, irritable moods, anxiety, depression, and insomnia
- Artificial sweeteners in general increased waist circumference 500 percent while aspartame increased blood sugar in diabetes–prone mice
- Aspartame has been found to contribute to the formation of tumors in the CNS such as gliomas, medulloblastomas, and meningiomas, increased lymphoma and leukemia, and is an excitotoxin to brain neurons
- Aspartame in the body further metabolizes to formaldehyde, and rat studies found that formaldehyde (as a metabolite of aspartame) caused increased TSH levels and worsens the capacity of the gland leading to thyroid failure

## Toxin Sensitivity

Food Dyes


Food dyes have been found to inhibit mitochondrial respiration: the ability of the powerhouse of your cells to convert nutrients to energy. They have also been found to especially affect those with ADHD.

- Your genotype combination is associated with a higher sensitivity to food dyes
- Avoid foods and drinks that use food dyes when possible

## Pesticides, Herbicides and Heavy Metal Sensitivity

Glyphosate


Glyphosate is an herbicide that has been found to be highly toxic.

- Your genotype is associated with potentially more cellular damage from exposure to the herbicide glyphosate
- The highest glyphosate levels have been found in non-organic wheat and non-organic pulses like beans, lentils, and peas
- A meta-analysis of human epidemiological studies suggests a link between exposures to glyphosate and an increased risk for non-Hodgkin's lymphoma
- An association between glyphosate and thyroid disease comes from plots over time of the usage of glyphosate in the U.S. on corn and soy time-aligned with plots of the incidence rate of thyroid cancer in the U.S.
- Manganese deficiency and toxicity can occur simultaneously from glyphosate exposure due to a disruption in liver enzymes, causing transportation of manganese through the vagus nerve to the brainstem where excess manganese can lead to Parkinson's disease
- The gut bacterium Lactobacillus is negatively impacted by glyphosate and the depletion in associated with celiac disease
- Humic acid from Shilajit has been shown in vivo to reduce glyphosate concentration, inhibit the destructive effect of glyphosate on beneficial bacteria, and protect and repair against tight junction injury of the digestive system

## Pesticides, Herbicides and Heavy Metal Sensitivity

Organochlorines


Organochlorines are found in certain pesticides, PCBs and sucralose.

- Your genotype is associated with improved protection against organochlorines

## Pesticides, Herbicides and Heavy Metal Sensitivity

Organophosphate Insecticides


PON1 plays a large role in removing pesticides and is also involved with supporting HDL function and LDL oxidation. Organophosphates are a class of insecticides, including parathion and chlorpyrifos, that were among the most widely used insecticides available until the 21st century.

- Your PON1 genotype is associated with reduced PON1 levels and detoxification of organphosphate insecticides
- Organophosophate insectides work by damaging an enzyme in the body called acetylcholinesterase
- Residential proximity to agricultural organophosphate application is associated with faster cognitive and motor symptom decline among Parkinson's disease patients
- Reduce exposure to pesticides, get adequate calcium and magnesium, and consume pomegranates, broccoli sprouts, and high quality olive oil to increase PON1 levels

## Pesticides, Herbicides and Heavy Metal Sensitivity

Cadmium


Chemical agriculture uses high amounts of synthetic organophosphates, creating a very high phosphorus content. Synthetic phosphorus concentrates the amounts of heavy metals, like cadmium in non-organic soils and food. Choosing organic produce is one of the best ways to avoid excess cadmium.

- Your genotype is associated with average detoxification of the heavy metal cadmium

## Pesticides, Herbicides and Heavy Metal Sensitivity

Mercury


Mercury is a neurotoxin linked to neurological and behavioral disorders including tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction. Burning coal for power and heat is a major source of mercury exposure. Glutathione is responsible for protecting against and detoxifying heavy metals like mercury.

- Your glutathione genotypes are associated with reduced protection against mercury toxicity
- Mercury is found in many pharmaceutical drugs, dental amalgams, and large fish including swordfish, ahi tuna, and halibut
- Selenium blocks mercury uptake, folate decreases mercury levels, and magnesium and holy basil protect against mercury toxicity

## Pesticides, Herbicides and Heavy Metal Sensitivity

Lead


Lead-based paint, lead-based dust in older buildings, contaminated water, and air pollution are the major sources of lead. Exposure to lead over time may cause abdominal pain, constipation, depression, distraction, forgetfulness, irritability, and nausea.

- Your genotype is associated with improved detoxification of lead

# MENTAL HEALTH & COGNITIVE PERFORMANCE

## Mental Health and Cognitive Performance

Brain Repair and Maintenance


Multiple genes are responsible for daily neural repair and maintenance, and a combination of genotypes are associated with decreased neural repair.

- Your genotype combination is associated with average to improved neural repair
- You can be proactive for neural repair with eight hours of sleep per night, DHA, B-vitamins, Lion's Mane mushrooms, zinc, vitamin C, and vitamin E

## Mental Health and Cognitive Performance

Concussion Recovery


A combination of genotypes in the pathways responsible for glutamate transport and modulation, BDNF levels, neural repair, and inflammation during a concussion are associated with delayed or improved recovery.

- Your genotype combination is associated with a moderate rate of recovery from concussions
- It is advised to be proactive with eight hours of sleep per night, zinc, omega-3 fatty acids, Lion's Mane mushroom, B6, lithium, magnesium, B2, folate, B12, vitamin C, choline, vitamin D, and consistent cardio
- University of Buffalo researchers published a study in the Clinical Journal of Sports Medicine that individualized exercise programs just below the onset of symptoms is safe and can relieve nearly all post-concussion symptoms

## Mental Health and Cognitive Performance

Episodic Memory


The 5-HT2A gene is associated with episodic memory, which is the ability to recall details of an event.

- Your 5-HT2A genotype is associated with a reduced episodic memory
- Episodic memory can be enhanced with tryptophan, green or black tea, catecholamines, betaine, and choline
- Mindfulness training, increasing your VO2 max and reducing your reliance on smartphones can also enhance episodic memory

## Mental Health and Cognitive Performance

Cardio, Mood and Cognitive Fitness


Cardiovascular exercise has a tremendous influence on neurotransmitter balance, memory and cognitive fitness.

- You have an average requirement for cardiovascular exercise to improve mood and cognitive fitness

## Mental Health and Cognitive Performance

Mood (Folate)


MTHFR genotypes determine folate requirements for healthy BH4 levels responsible for neurotransmitter balance. The current daily value for folate is 400mcg DFE.

- Your genotype may require 400–500mcg (or more) for healthy BH4 levels responsible for neurotransmitter balance
- Foods high in folate include:
- Liver (215mg) 3 oz.
- Spinach (131mg) 1/2 cup cooked
- Asparagus (89mg) 4 spears
- Brussels sprouts (78mg) 1/2 cup
- Broccoli (52mg) 1/2 cup

## Mental Health and Cognitive Performance

Anxiety (Choline)


The PEMT gene is associated with your required choline intake to support memory, anxiety, and REM sleep.

- Your PEMT genotype is associated with a higher need for choline (550mg or more) to support memory, anxiety and REM sleep
- Research has shown that uridine, DHA, and choline combined increases levels of phosphatidylcholine in the brain more than each on their own
- Foods high in choline include:
- Liver (356mg) for 3 oz.
- Egg (294mg) for 2 eggs
- Beef top round (234mg) for 6 oz.
- Chicken breast (144mg) for 6 oz.
- Chicken thigh (120mg) for 6 oz.
- Edamame (107mg) for 1/2 cup

## Mental Health and Cognitive Performance

Addiction


ANKK1 modulates the density of dopamine receptors in the brain and is the most-studied genetic variant related to addictions. Variants have been associated with alcoholism, opioid addiction, sugar addictions, compulsive eating, obesity and Internet addiction.

- Your genotype is associated with a lower density of dopamine receptors for the ANKK1 gene, reducing dopamine targets within the striatum of the brain
- Lower dopamine targets could lead to a higher likelihood of addictive behaviors
- Getting 8 hours of sleep per night, keeping your blood sugar balanced with adequate protein and fiber, high-intensity exercise, lower media exposure, vitamin D, healthy iron levels, omega-3's, and meditation all increase dopamine receptor density

## Mental Health and Cognitive Performance

Anxiety (Glutamate and GABA)


Anxiety is linked to altered levels of one or multiple neurotransmitters. Understanding the genetic link to specific levels of neurotransmitters can help you be precise in your approach to reducing anxiety.

- Your genotype combination is associated with an improved modulation of glutamate levels that could help prevent glutamate-related anxiety

## Mental Health and Cognitive Performance

Fear Response


The FAAH gene is associated with anandamide levels, correlated with a heightened fear response to potential threats, while BDNF variants affect the ability to extinguish the fear response.

- Your genotype combination is associated with a heightened fear response that may affect your ability to extinguish fear memories
- Getting 30 minutes or more of aerobic exercise per day (especially in altitude), CBD, and hops help increase anandamide – known as the "bliss molecule" – to reduce the fear response

## Mental Health and Cognitive Performance

Reward System


COMT rs4680 has been linked in a meta-analysis to variations in the reward response based on genotypes associated with low and high dopamine levels.

- Your genotype is associated with a lower dopamine response to reward processing that could negatively affect motivation and delay decision making
- Creating deadlines for short term tasks and long term goals can help create pressure and elevated dopamine levels to improve motivation and decision making
- To boost low dopamine with diet and exercise, you can increase your intake of coffee, green tea, chocolate, bananas, and berries, or exercise with an element of risk

## Stress Management

Stress Perception

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

Your perception of stress is unique to your genotypes and life experience. Variants in 5-HT2A are associated with perceived stress, low vagal tone, anxiety, depression, OCD, and IBS, especially in females.

- Your genotypes are associated with a higher perception of stress
- Moderate intensity aerobic exercise, meditation and yoga are recommended for stress relief
- Tryptophan, green or black tea, prebiotics, probiotics, B2, B6, B12, and folate all target the 5-HT2A gene to help lower stress perception

## Stress Management

Stress and Digestion

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

The G allele carriers of ADRB2 were associated with a higher percentage of IBS cases, twice the rates of anxiety, and functional chest pain diagnoses.

- Your genotype is associated with a higher percentage of digestive issues from stress and elevated adrenaline levels
- If you experience any of these, you may benefit from a deep breathing practice, meditation, yoga, vitamin C, and magnesium to modulate adrenaline levels

## Stress Management

Weight Training and Stress Relief

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

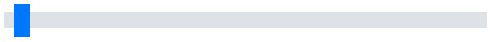
Weight lifting has a higher impact on hormonal pathways that may provide higher levels of stress relief based on the speed of these pathways.

- Your genotype is associated with a lower level of dopamine and adrenaline, and weight lifting may have less of an impact on stress compared to other genotypes

## Warrior or Strategist

Pressure Response

WARRIOR | HYBRID (BOTH) | STRATEGIST



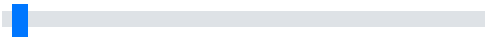
Your COMT genotype is associated with the "Warrior" that has lower dopamine levels, but a higher threshold for pressure and may even thrive in those environments. Lower dopamine levels are useful in threatening environments where maximal performance is required despite threat and pain.

- To boost low dopamine for mood and concentration, you can increase your intake of coffee, green tea, chocolate, bananas, and berries, or exercise with an element of risk

## Sleep Support

Sleep Duration Requirement

AVERAGE SLEEP | MORE SLEEP



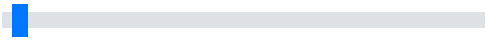
The ApoE gene is associated with average or extended sleep requirements for healthy brain repair each night.

- Your ApoE genotype is associated with average sleep duration (7-8 hours) requirements for neural repair

## Sleep Support

Recommended Wake Time

EARLY | AVERAGE | LATE



Research has found that MTNR1B G allele carriers had a significant association with delayed melatonin release in the evenings and a substantially longer duration of elevated melatonin levels in the morning.

- Due to melatonin release ending earlier in the morning for your genotype, an earlier wake time (earlier than 6:30am) may be easier for without light exposure
- Melatonin supplementation was not found to cause impaired glucose intolerance for your CC genotype

## Sleep Support

Caffeine Sleep Disturbance

LESS LIKELY | AVERAGE | MORE LIKELY

The rate at which caffeine is metabolized genetically is associated with variations of sleep disturbance.

- You are an intermediate metabolizer of caffeine, which could affect sleep if caffeine is consumed in the late afternoon or evening
- To accelerate the metabolism of caffeine, schedule cardio exercise after consumption and increase cruciferous vegetable intake

## Sleep Support

REM Sleep

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

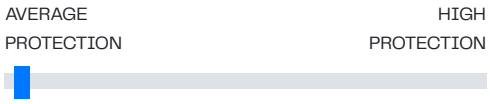
Acetylcholine plays a role in promoting REM sleep, the phase that occurs while we dream and where memory consolidation occurs.

- Your genotype is associated with increased sensitivity to not meeting your daily choline requirements for acetylcholine production and REM sleep
- You may be more sensitive to anticholinergic drugs, which block acetylcholine and have been found in research to cause cognitive decline
- Make sure you are getting at least 550mg of choline per day, walking 45 minutes or more per day, and if consuming alcohol, you will sleep better if you consume it before 6:00pm and limit the quantity


IMMUNE SUPPORT

## Bacteria, Yeast, Parasites and Viruses

H. Pylori




The inactive “non-secretor” genotype for FUT2 confers resistance to H. Pylori. H. Pylori is present in approximately 50% of the population in developed countries.

- You do not have the non-secretor genotype for FUT2, associated with an average susceptibility to H. Pylori
- H. Pylori inhibition has been demonstrated with alcohol extracts of the mushroom Lion's Mane

## Bacteria, Yeast, Parasites and Viruses

Candida


The inactive “non-secretor” genotype for FUT2 decreases resistance to Candida overgrowth.

- You have the secretor genotype for FUT2, giving you an average susceptibility to Candida overgrowth

## Bacteria, Yeast, Parasites and Viruses

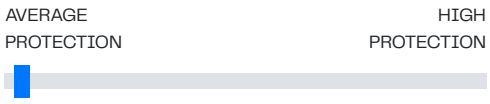
Malaria


Research has shown that MTHFR genotypes influence T-lymphocytes, natural killer cells, and protection against malaria.

- Your genotype is associated with moderate protection against malaria
- The malaria parasite needs higher amounts of folate to survive and replicate
- For malaria-endemic regions, your genotype does not provide as much protection as the homozygous genotype, but you have more protection than the wild-type genotype

## Bacteria, Yeast, Parasites and Viruses

Norovirus




The inactive “non-secretor” genotype for FUT2 confers resistance to the Norovirus.

- You do not have the non-secretor genotype for FUT2, associated with an average susceptibility to the Norovirus

## Bacteria, Yeast, Parasites and Viruses

DNA Viruses

AVERAGE PROTECTION | MODERATE PROTECTION | HIGH PROTECTION

DNA viruses include HPV, Epstein Barre, herpes, and smallpox. Folate is a precursor to BH4 to produce nitric oxide. Nitric oxide acts as an antiviral that is more potent against DNA viruses.

- Your genotype combination is associated with slightly lower BH4 levels with insufficent folate, lowering protection against DNA viruses
- Low BH4 affects the aggressiveness of DNA viruses
- To increase BH4, include foods high in folate, vitamin C, L-arginine, B6, magnesium, and selenium for healthy nitric oxide levels and DNA virus support
- BH4 is depleted by high blood sugar, high omega-6 intake, chronic stress, high levels of mercury, arsenic, lead and aluminum, aspartame, and oxidative stress

## COVID-19

Glutathione

AVERAGE NEED | INCREASED | HIGH

Glutathione is the master antioxidant system involved in oxidative stress, detoxification, and immunity. The functional capacity of immune cells and the ability to cope with oxidative stress has been proposed as one of the significant markers of health and longevity. In both animals and humans, those who reach exceptionally old age have immune markers the same as young adults.

- Your genotype combination is associated with decreased baseline glutathione levels
- Glutathione decreases with age, and low levels of glutathione are associated with chronic exposure to chemical toxins, heavy metals and excess alcohol, immunocompromised conditions, and neurodegenerative disorders
- Glutathione has been found to increase by 20% with deep breathing practices like Tai Chi or yoga
- For exercise, a combination of aerobic exercise and circuit weight training produced the highest glutathione effect
- Selenium, glycine, cysteine, vitamin C, and cruciferous vegetables all improve glutathione levels
- Chicken or bone broth, herbs, and spices are some of the best dietary ways to maintain higher levels of glutathione
- Some of the all-stars include cinnamon, anise, sage, and thyme due to also containing the antiviral compound caffeic acid

## COVID-19

Vitamin A

AVERAGE NEED | INCREASED | HIGH

Vitamin A and some other retinoids show important immunomodulatory properties, including the ability to increase the efficiency of actions of type 1 interferons, an important antiviral cytokine released by the innate immune system against viral infections. Coronaviruses similar to SARS-CoV-2 can suppress the host IFN-I-based antiviral response as part of their infection mechanism.

- Your genotype is associated with a 32% lower conversion rate of beta-carotene to vitamin A, making it important to include more animal-based vitamin A to hit your daily target
- Vitamin A intake by country shows that Spain is the country with the lowest population meeting nutritional requirements for vitamin A, followed by Belgium and Finland
- Germany and Portugal show the best, and with the exception of Finland, countries with suboptimal Vitamin A status are correlated (although not significantly) with their COVID-19 incidence and mortality

## COVID-19

Vitamin C

AVERAGE NEED | INCREASED | HIGH

Optimal status of vitamin C plays an important role in the proper working of the immune system.

- Your genotype is associated with average serum vitamin C levels
- Countries such as the UK, France, Netherlands, and Belgium do not reach optimal dietary intake of vitamin C
- Germany stands out for its level of vitamin C intake in comparison with other countries
- Despite suboptimal vitamin C intake correlating weakly with COVID-19 incidence, it correlates strongly with deaths percentage, which could suggest a positive effect to fight infection once the individual has already been infected with SARS-CoV-2

## COVID-19

Vitamin D

AVERAGE NEED | INCREASED | HIGH

Vitamin D plays a key role in modulating the immune system, and suboptimal or deficient consumption of vitamin D is associated with various conditions related to a malfunction of the immune system and dysregulations in inflammatory status.

- Your genotype is associated with below average circulating levels of vitamin D
- Vitamin D intake is deficient in all countries studied with COVID severity, with Spain, France, and Italy as the countries with the lowest intake
- A meta-analysis of the studies appears to show that vitamin D is only useful for those who are clinically low (below 20 ng/ml), with moderate doses daily or weekly to raise levels being more effective than periodic large doses

## COVID-19

Selenium

AVERAGE NEED | INCREASED | HIGH

Suboptimal or deficient levels of selenium are associated with decreased cytotoxicity of NK cells, decreased antibody titers, and impaired cellular immunity. Supplementation is commonly related to improvements in cellular immunity and an improved optimal immune response against viruses, including an inhibitory effect on the development of the poliovirus and influenza.

- Your genotype is associated with an average need for selenium
- Glutathione peroxidase 1 (GPX1) is a selenoenzyme with described antioxidant and antiviral properties that depends on nutritional selenium status
- Spain is at the top for meeting selenium requirements while Denmark is at the bottom
- The only two populations above the median of the countries analyzed included Finland and France, while the rest of the countries are below the general median

## COVID-19

B12

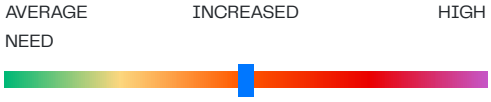
AVERAGE NEED | INCREASED | HIGH

Sufficient vitamin B12 intake is essential for antibody production and a deficiency is related to a lower concentration of circulating lymphocytes and altered antibody-based responses. SARS CoV-2 infection is related to an aggravation of the cellular metabolism and the homocysteine pathway causing severe complications from COVID-19, and the correct supply of vitamin B12, folate and B6 may be crucial for COVID-19 patients.

- Your genotype is associated with intermediate B12 levels
- Some of the countries least affected by SARS-CoV-2 show the highest levels of vitamin B12 intake (Portugal and Finland)
- Some of the countries most affected by SARS-CoV-2 (Belgium and Spain) have intakes below the median

## COVID-19

Folate




Folate is crucial for optimal Th-1 mediated immune response and proper antibody production. Suboptimal levels of folate may trigger imbalances in T and NK cell mediated immune responses and decrease the amount of antibody production.

- Your genotype combination is associated with a higher than average need for folate
- The correct intake of vitamin B6, folate and B12 in patients affected by COVID-19 has been proposed as part of the disease treatment, even by supplementation formulas, in an attempt to regulate the disruption of cellular metabolism of the homocysteine pathway caused by the SARS-CoV-2 infection

## COVID-19

B6 (Pyridoxine)


Vitamin B6 is essential for maintaining cytotoxic activity of NK cells, lymphocyte development, and B-cell antibody production. Suboptimal intake is associated with lower concentrations of circulating lymphocytes, impaired lymphocyte maturation, and decreased antibody-based responses.

- Your genotype is associated with normal serum B6 levels
- The correct intake of vitamin B6, folate and B12 in patients affected by COVID-19 has been proposed as part of the disease treatment, even by supplementation formulas, in an attempt to regulate the disruption of cellular metabolism of the homocysteine pathway caused by the SARS-CoV-2 infection

## COVID-19

Bifidobacteria


Approximately 80% of your immune system is in your gut. The good bacteria bifidobacterium is highest in breast-fed infants and has been found to be lower in the higher-risk demographics for COVID-19 including those with diabetes, obesity, asthma and the elderly. Bifidobacteria populations have been found to vary based on the FUT2 genotype.

- Your genotype is associated with improved bifidobacteria levels in the gut, helping to protect against lower and upper respiratory infections
- Prebiotics – found in foods like bananas, garlic, leeks, barley, asparagus, pistachios, onions, and polyphenol-rich foods – have been found in human trials to increase bifidobacteria levels

## COVID-19

Glycine


Glycine is one of the three major amino acids for glutathione production, protecting the body from oxidative damage during the immune response, and supporting T-cell proliferation.

- Your genotype is associated with low type 1 collagen production, increasing your glycine requirement
- Type I collage is a major structural protein in the lung and is stimulated during certain inflammatory reactions in the lung
- Collagen protein, bone, or chicken broth that gelatinizes, gelatin, meat with the skin, ribs, shanks, and drumsticks are all ways to increase dietary glycine
- Baobab is considered an exceptionally good source of plant-based glycine found in the hunter-gatherer Hazda diet

## COVID-19

Anthocyanins

AVERAGE NEED | INCREASED | HIGH

Anthocyanins, the purple antioxidant compound in elderberries and other red and purple plants, have impressive antiviral activity against RNA viruses (SARS-CoV-2 is a RNA virus), while also increasing HDL and lowering LDL.

- Your ApoE genotype is more responsive to anthocyanin intake, and therefore your requirement is average for viral support

# DNA PROTECTION & REPAIR

## DNA Protection & Repair

Glutathione Protection


Glutathione is the master antioxidant system involved in oxidative stress, detoxification, and immunity. Glutathione status parallels telomerase activity, an important indicator of lifespan.

- Your genotype combinations are associated with decreased baseline glutathione levels
- Glutathione decreases with age, and low levels of glutathione are associated with chronic exposure to chemical toxins, heavy metals and excess alcohol, immunocompromised conditions, and neurodegenerative disorders
- Glutathione has been found to increase by 20% with deep breathing practices like Tai Chi or yoga
- For exercise, a combination of aerobic exercise and circuit weight training produced the highest glutathione effect
- Selenium, glycine, cysteine, vitamin C, and cruciferous vegetables all improve glutathione levels
- Chicken or bone broth, herbs, and spices are some of the best dietary ways to maintain higher levels of glutathione
- Some of the all-stars include cinnamon, anise, sage, and thyme due to also containing the antiviral compound caffeic acid

## DNA Protection & Repair

Catalase Protection


CAT makes an enzyme called catalase, which helps reduce oxidative stress. CAT is present in all aerobic cells while research has found the highest correlation to prostate, breast, liver, and blood health.

- Your genotype is associated with improved catalase levels

## DNA Protection & Repair

Mitochondrial Protection


The SOD2 gene is responsible for superoxide dismutase levels, an important protector of the mitochondria, the powerhouse of the cell.

- Your genotype is associated with slightly reduced mitochondrial protection
- Manganese, boron, vitamin A, C, E, omega-3 fatty acids, CoQ10, lutein, lycopene, milk thistle, cordyceps, holy basil, reishi and cryotherapy all increase mitochondrial protection

## DNA Protection & Repair

UV Protection


One hypothesis for variants in MTHFR 677 is that they were selected based on higher folate intake and UV exposure, both common in Mediterranean climates. What happens in the body when MTHFR enzymatic function is reduced is that thymidine production increases. Thymidine enhances the repair of UV-induced DNA damage to help quickly repair sun damage.

- Your MTHFR genotype is associated with moderate UV protection from the sun
- To improve UV protection, increase your intake of folate-rich greens, blackberries, wild salmon, cacao powder, schisandra, reishi, dill and dried parsley

## DNA Protection & Repair

Skin Protection


GPX1 activity is considered to be the most important antioxidant enzyme defense mechanism in the skin.

- Your genotype is associated with improved antioxidant protection for the skin

## DNA Protection & Repair

Lung Protection


Variants in the GSTP1 gene have been associated with lower antioxidant support in the lungs when exposed to environmental pollution.

- Your genotype is associated with increased lung protection against environmental pollutants

## DNA Protection & Repair

Colon Protection


The MLH1 gene codes for a DNA repair enzyme linked to colon health.

- Your genotype is associated with improved DNA protection for colon health

## DNA Protection & Repair

Cured Meat and Colon Health


A large-scale genome-wide analysis of over 18,000 people from the U.S., Canada, Australia and Europe found that variants in GATA3 were associated with an increased risk of colon cancer for those eating processed meat compared to those with the normal genotype.

- Your genotype is associated with an increased risk of colon cancer from cured meat consumption
- Keeping a vitamin D level of 34 ng/ml or higher has been found to cut colon cancer risk in half
- A high intake of fruits, vegetables, herbs and spices have also been found to dramatically reduce the risk of colon cancer

## DNA Protection & Repair

Eye Protection


Blue light is a high-energy or short-wavelength visible light from your phone and computer that induces inflammation and retinal diseases such as age-related macular degeneration and retinitis pigmentosa.

- Your genotype is associated with higher requirements for foods high in lutein, zeaxanthin, and anthocyanins for eye health
- A meta-analysis found that the rates of myopia (nearsightedness) will increase 140% by 2050 due to our increased time in front of a screen
- Research has found that bilberry and lingonberry exert protective effects against blue LED light-induced retinal photoreceptor cell damage due to their polyphenol content
- Increase your dietary intake of dark purple berries, dark leafy greens, summer squash, green peas, broccoli and Brussels sprouts

## DNA Protection & Repair

Thyroid Protection


Up to 60 percent of those with a thyroid disorder are unaware of their condition. The cause is considered largely unknown and occurs 10 times more in women than in men. Hashimoto's disease runs in the family and 70%–80% of susceptibility to autoimmune thyroid disease is based on genetics.

- Your genotype combination is associated with reduced thyroid protection and a slightly increased risk of Hashimoto's disease
- Autoimmune thyroid disease is associated with celiac disease
- A deficiency in selenium is associated with celiac disease and thyroid disease, and plays a significant role in thyroid hormone synthesis, secretion and metabolism
- Sucralose and glyphosate destroy gut flora like lactobacillus, which disturbs selenocysteine levels present in the catalytic center of enzymes that protect the thyroid from free radical damage
- The artificial sweetener aspartame in the body further metabolizes to formaldehyde, and rat studies found that formaldehyde (as a metabolite of aspartame) caused increased TSH levels and worsens the capacity of the gland leading to thyroid failure

## DNA Protection & Repair

Pancreas Protection


Multiple genes are linked to DNA protection for pancreatic health.

- Your genotype combination is associated with increased DNA protection for pancreatic health

## DNA Protection & Repair

Bladder Protection

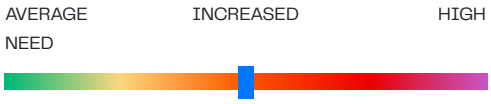

Certain gene combinations have been found to decrease the detoxification ability of certain toxins found to be carcinogenic for the bladder.

- Your genotype is associated with decreased DNA protection for bladder health
- Avoid tobacco smoke, commercial hair dyes, working in industrial and manufacturing plants, charred meat, and diesel exhaust
- Increase your cruciferous vegetables, carotenoid, and vitamin C intake


METHYLATION

## Methylation

Folate

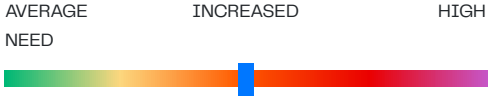



MTHFR 677 and MTHFR 1298 genotypes determine your folate requirements to assist normal homocysteine levels.

- Your genotype combination is associated with a higher than average requirement for folate to maintain healthy homocysteine levels
- If your homocysteine is elevated, check that you are getting enough folate
- High homocysteine has been implicated in amyloid buildup, DNA damage and cancer, mitochondrial dysfunction, cardiovascular disease, age-related macular degeneration, apoptosis of neurons and depression

## Methylation

Folinic Acid




Folinic acid is a second type of folate found in folate-rich food.

- You have a higher than average requirement for folinic acid to maintain healthy methylation and homocysteine levels

## Methylation

Vitamin B6


Vitamin B6 plays an important role in homocysteine metabolism and CBS gene function.

- A combination of your genotypes related to vitamin B6 serum levels and methylation requirements are associated with an average requirement for B6 to maintain healthy methylation and homocysteine levels

## Methylation

Vitamin B12


Vitamin B12 plays an important role in homocysteine metabolism.

- You have an average requirement for B12 to maintain healthy methylation and homocysteine levels

## Methylation

Riboflavin (B2)


Vitamin B2 plays a special role in stabilizing the MTHFR gene for homocysteine metabolism.

- Your genotype is associated with a higher than average requirement for riboflavin to maintain healthy methylation and homocysteine levels
- B2 is highest in liver, lamb, fish, yogurt and mushrooms

## Methylation

Choline and Betaine


Choline and betaine play a crucial role in homocysteine metabolism, especially for those with variants in MTHFR.

- Your genotype is associated with a higher than average requirement for choline and betaine to maintain healthy methylation and homocysteine levels
- Low choline intake can manifest as memory issues, NAFLD, anxiety, neurological disorders, breast cancer, histamine issues, gallbladder issues, and SIBO
- Choline may be depleted by nighttime pain relievers, antihistamines, sleep aids, antidepressants, incontinence drugs and narcotic pain relievers
- Intense endurance exercise depletes choline levels, and increasing phosphatidylcholine has been found to improve exercise capacity during high-intensity cycling and running, as well as reduce muscle soreness

## Methylation

Synthetic Folic Acid


Certain genotypes in the folate metabolism pathway can affect the metabolism of synthetic folic acid, leading to high circulating levels.

- Your genotype combinations may improve the metabolism of synthetic folic acid

# HORMONE SUPPORT

## Hormone Support

Estrogen Detoxification


There are multiple genes in the estrogen detoxification pathway that have a cumulative value on the ability to properly detoxify estrogen.

- Your combination of numerous genotypes in the estrogen pathway are associated with reduced estrogen detoxification
- To reduce the risk of harmful estrogen metabolites, you should avoid xenoestrogens, manage stress levels, and focus on gut health
- Increasing prebiotic fiber, polyphenols, magnesium and bifidobacteria may improve breast health by reducing the amount and activity of harmful estrogen metabolites

## Hormone Support

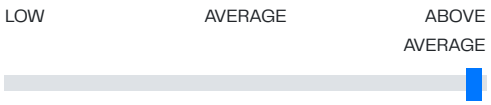
Prostate Protection


Numerous gene combinations are required to determine a cumulative value of prostate protection.

- Your genotype combination is associated with reduced prostate protection
- Improve prostate protection with selenium, vitamin C, B1, B6, folate, zinc, magnesium, healthy iron levels, milk thistle, holy basil, and cruciferous vegetables

## Hormone Support

Testosterone Levels




A combination of genotypes have been associated with low, average and above average testosterone levels.

- Your genotype combination is associated with above average baseline testosterone levels
- Testosterone peaks throughout puberty and continues to stay in optimal ranges until around 40 years old

## Hormone Support

Oxidative Stress and Fertility


Pesticides, cadmium, mercury, and arsenic have all been shown to lower GSTP1 expression, increasing the elevation and toxicity of these chemicals and heavy metals. The exposure and sensitivity to these chemicals and heavy metals are suspected reasons for the increased risk of male infertility related to GSTP1 variants.

- Your genotype is associated with improved sperm protection against environmental pollution.

## Hormone Support

T3 and T4


T3 and T4 level variations have been associated with variants in the DIO1 gene.

- Your genotype is associated with normal T3 and T4 levels
- T3 and T4 can still be out of range based on other epigenetic factors

## Hormone Support

Adiponectin

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

ADIPOQ encodes for adiponectin, a protein secreted by fat cells that affect insulin and glucose metabolism. Low levels of adiponectin play a role in obesity, insulin resistance and Type 2 diabetes.

- Your genotype is associated with normal adiponectin levels, which can increase the effect of insulin, improve glucose metabolism and assist a healthy body weight

## Hormone Support

Ghrelin

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY

Variants in genes related to ghrelin levels and dopamine receptor density have been shown to create a larger appetite and the potential for overeating in multiple populations.

- Your genotypes are associated with borderline higher ghrelin levels that could lead to overeating and abdominal weight gain
- A focus should be on a protein and fiber-rich breakfast, monounsaturated and polyunsaturated fats, 7-8 hours of sleep per night, healthy vitamin D levels and aerobic exercise over 1 hour or high intensity exercise to stabilize ghrelin levels

# CARDIOVASCULAR HEALTH & EXERCISE

## Cardiovascular Health

HDL and LDL


ApoE is connected to HDL and LDL levels, while PON1 is involved with supporting HDL function and LDL oxidation, an important mechanism in atherosclerosis and heart disease.

- Your genotype combination is associated with a higher likelihood of good HDL levels and a lower likelihood of higher levels of LDL, oxidized LDL, and total cholesterol

## Cardiovascular Health

VLDL


Subjects with variants in PPAR-alpha have been found to have a larger waist circumference and a higher proportion of small, dense LDL particle size.

- Your genotype is associated with a higher proportion of small, dense LDL particle size if following a high saturated fat and low polyunsaturated fat diet

## Cardiovascular Health

Triglycerides


Variants in the FADS1 SNP (rs174546) are associated with elevated triglyceride levels.

- Your genotype is associated with elevated triglycerides
- Numerous studies have found that omega-3 fatty acids administered as fish oil supplements lowers plasma triglyceride levels by 25% to 34%

## Cardiovascular Health

ApoB


ApoB is a protein that is involved in the metabolism of lipids and is the main protein constituent of lipoproteins. High levels of ApoB, especially with the higher LDL particle concentrations, are the primary driver of arterial plaque. The PPAR-alpha polymorphism has been associated with ApoB in many populations such as Caucasians, Indians, and African-Americans.

- Your genotype is associated with elevated ApoB levels
- Lowering saturated fat intake and increasing polyunsaturated fat intake is recommended
- PPAR-alpha can be targeted with astaxanthin (high in wild salmon), pterostilbene (blueberries, mulberries, cranberries, raw almonds), genistein (fermented soy), tomatoes, cinnamon, zinc, Lion's Mane mushroom, Gynostemma tea and L-carnitine

## Cardiovascular Health

Lp(a)


Lp(a )is a sticky form of LDL that appears to affect plaque growth, LDL particle size and increase the risk of plaque rupture and blood clotting.

- Your genotype is not associated with elevated Lp(a) levels

## Cardiovascular Health

Raw Plant Intake

AVERAGE | MEDIUM PRIORITY | HIGH PRIORITY

The risk of heart attacks and cardiovascular disease conferred by the 9p21 gene appears to be modified by a prudent diet high in raw vegetables and fruits for South Asian, Latin American, Arab, Chinese and European populations for variants in rs4977574.

- You have a higher than average requirement for raw fruits and vegetables to maintain a healthy heart

## Cardiovascular Health

Nitric Oxide

AVERAGE | MEDIUM PRIORITY | HIGH PRIORITY

The uncoupling of nitric oxide has been linked to play an essential role in cardiovascular pathologies including dilated cardiomyopathy, ischemia-reperfusion injury, endothelial dysfunction, atherosclerosis, and hypertension.

- Your genotype combinations are associated with a higher than average need for folate to produce adequate BH4, the precursor to nitric oxide
- BH4 is depleted by high blood sugar, high omega-6 intake, chronic stress, high levels of mercury, arsenic, lead and aluminum, aspartame, and oxidative stress
- Other strategies to increase BH4 include vitamin C, L-arginine, B6, magnesium, and selenium

## Cardiovascular Health

Homocysteine

AVERAGE | MEDIUM PRIORITY | HIGH PRIORITY

Homocysteine is a non-protein amino acid that is produced from methionine, can be recycled back into methionine and converted into cysteine in the methylation cycle. High homocysteine levels have been connected to depression, blood clots, inflammation, macular degeneration, dementia, and cancer.

- You have a higher than average need for folate to maintain healthy homocysteine levels

## Cardiovascular Health

Blood Clots

AVERAGE | MEDIUM PRIORITY | HIGH PRIORITY

Deep vein thrombosis is a condition that occurs when a blood clot forms in a vein deep inside a part of the body and is most common for those over 60. Variants in F5 increase the risk of deep vein thrombosis.

- Your genotype is not associated with deep vein thrombosis

## Cardiovascular Health

Uric Acid

AVERAGE | MEDIUM PRIORITY | HIGH PRIORITY

Variants in the ABCG2 gene have been associated with elevated uric acid levels and an increased risk of gout in Asians, Europeans, African Americans, Mexican Americans, and American Indians. Epidemiological studies have shown that uric levels are positively correlated with gout, hypertension, atherosclerosis, atrial fibrillation, and heart failure.

- Your genotype is associated with average uric acid levels

## Cardiovascular Health

Hemochromatosis


A homozygous HFE C282Y may lead to an iron overload due to increased iron absorption and disrupted metabolism. Common HFE mutations account for more than 90% of hemochromatosis phenotypes in whites of western European descent.

- Your wild-type HFE genotype is associated with a reduced likelihood of genetically linked hemochromatosis

## Exercise

Power Athlete Potential


ACTN3 is currently the most promising gene for predicting the likelihood of becoming an Olympic level sprint and power athlete in males and females. The RR (CC) genotype expresses the ACTN3 protein found in Type II muscle fibers, which produces explosive and powerful contractions.

- You have the XX genotype that is associated with reduced power and hypertrophy response to resistance training
- The XX genotype results in a complete lack of expression of α-actinin-3 and Type II muscle fibers, occurring in approximately 20% of the world's population
- Lower power and hypertrophy response from training

## Exercise

Weight Lifting Inflammation


Weight lifting leads to a variation in muscle inflammatory markers based on genetics and intensity.

- Your genotype combination is associated with higher levels of muscle inflammation (creatine kinase) for weight lifting and may delay recovery time
- To accelerate recovery, ice baths, whey protein, American ginseng, curcumin, vitamin C, and collagen protein have all been found to attenuate creatine kinase levels

## Exercise

Endurance Exercise Inflammation


Endurance training leads to a variation in creatine kinase levels based on genetics.

- Your genotype combination is associated with higher levels of muscle inflammation (creatine kinase) for endurance exercise and may delay recovery time
- To accelerate recovery, whey protein, cold water immersion, American ginseng, curcumin, optimal testosterone levels, vitamin C and collagen protein have all been found to attenuate creatine kinase levels

## Exercise

High-Intensity Exercise Inflammation


High-intensity exercise is defined as 70% to 85% of your maximum heart rate, and inflammation variation has been associated with the SOD2 gene.

- Your SOD2 genotype is associated with less muscle inflammation in response to high-intensity exercise

## Exercise

ACL and Shoulder Dislocation Risk


The COL1A1 gene is associated with ACL and shoulder injury risk.

- Your COL1A1 genotype is associated with an increased need for dietary collagen to prevent ACL and shoulder injuries
- Vitamin C, zinc, copper, glycine, proline, lysine, and B6 are all precursors to collagen production

## Exercise

Ankle and Hamstring Injury Risk


The ACTN3 gene is linked to increased or decreased risk of ankle and hamstring injuries.

- Your ACTN3 genotype is associated with an increased risk of ankle and hamstring injuries
- More attention is recommended to strengthen the ankles and hamstrings including the Nordic hamstring exercise and post-workout recovery methods for injury prevention

## Exercise

Cold Endurance


The ACTN3 gene is associated with a lower or higher adaptation rate to cold endurance.

- You have the ACTN3 XX genotype, associated with a higher adaptation rate to cold endurance
- The X allele frequency correlates with higher latitude and lower temperature, showing a possible selection for cold tolerance and famine
- Researchers found that the selection of XX appears to be for more fatigue-resistant muscles that generate heat from activation of brown adipose tissue

## Exercise

Caffeine Response for Exercise Under 1 Hour


The CYP1A2 gene is associated with caffeine response for improving or decreasing exercise performance.

- Caffeine was not found to improve or decrease exercise performance for your CYP1A2 genotype

## Exercise

Caffeine Response for Exercise Over 1 Hour


The CYP1A2 gene is associated with caffeine response for improving or decreasing exercise performance.

- Caffeine was not found to improve or decrease exercise performance for your CYP1A2 genotype

# STRENGTHS

This section is a thorough overview of your individual gene function across the entire analysis in just a few pages. If you are looking for a brief summary of the most important parts of your report without doing a deep dive into the genotype tables and clinical research sections, this is the place to start. Be proud of your inherent genetic strengths!

## DIGESTION

- **Prebiotics, Probiotics and B12-FUT2** - The GG FUT2 genotype in European, African, and Indian populations is associated with improved bifidobacteria populations in the gut compared to the AA genotype, increasing immune function against respiratory infections.
- **Vitamin C-SLC23A1** - Your genotype is associated with improved whole-body vitamin C homeostasis through dietary absorption and renal reabsorption.
- **Iron** - Your genotype is associated with a lower risk of iron overload for the HFE C282Y gene. However, a heterozygous HFE C282Y and HFE H63D gene could change this result.
- **Saturated Fat-PPAR-alpha** - You have the wild-type genotype that is associated with improved saturated fat metabolism and ketone body production during fasting. Assess your other fat metabolism genes for a more complete assessment.
- **Ghrelin and Appetite-FTO** - Your genotype is associated with normal ghrelin levels (hunger hormone), decreasing the risk for overeating and abdominal weight gain.
- **Saturated Fat-APOA2** - Your genotype is associated with a reduced likelihood of saturated fats causing weight gain.
- **Carbohydrates-TCF7L2** - Your genotype is associated with an improved insulin response for grain-based carbohydrates.
- **Lactose** - You have the homozygous AA genotype that is associated with a lower probability of lactose intolerance.
- **Uric Acid-ABCG2** - Your genotype is associated with a lower probability of chronically elevated uric acid levels.
- **Ethanol Metabolism-ALDH2** - Your genotype is less likely to experience facial flushing from alcohol due to improved acetaldehyde metabolism.

## METHYLATION

- **Folate-MTHFD1 G1958A** - Your genotype is associated with improved metabolism for folinic acid, the second most common type of folate after methylfolate.
- **Folate-DHFR** - Your genotype is associated with an improved breakdown of synthetic folic acid at the beginning of the folate cycle. However, variants in MTHFR 677 can also affect folic acid metabolism.
- **B12, B2 and Zinc-MTR** - You may have improved MTR function, assisting homocysteine metabolism.
- **B12-MTRR** - Your genotype is associated with improved gene function, assisting B12 and homocysteine metabolism.
- **Magnesium-MAT1** - If you are male, your genotype is associated with improved MAT1 gene function, assisting normal SAMe levels for healthy glutathione levels, joint and low back pain, a balanced mood, and liver detoxification.
- **Choline-PEMT** - Your genotype is associated with improved phosphatidylcholine production for a healthy liver, and to assist normal homocysteine levels.
- **Arsenic-CBS** - Your genotypes are associated with improved arsenic metabolism and detoxification for the CBS genes.

## HORMONES

- **Testosterone-Men** - If you are male, your genotype is associated with improved total and free testosterone levels for the SHBG rs6258 gene.
- **Thyroid-DI01** - Your genotype is associated with improved DI01 gene function for T3 and T4 thyroid function, however other epigenetic factors should be assessed.
- **Thyroid-DI02** - Your genotype is associated with improved T3 and T4 thyroid function in the brain for the DI02 gene.
- **Estrogen Metabolism-CYP1A1** - Your CYP1A1 wild-type genotype is improved for the beginning phase of estrogen metabolism. Please review all genes involved in estrogen metabolism for a complete picture of the process.
- **Estrogen Metabolism-COMT** - For estrogen metabolism and detoxification, those with the fast GG COMT V158M genotype may have a reduction in harmful estrogen metabolites that can cause DNA damage. However, you may need a higher green tea polyphenol intake to obtain the same benefits as the other COMT genotypes due to a faster metabolic rate.
- **Estrobolome-FUT2** - Your wild-type genotype is associated with improved bifidobacteria gut bacteria, assisting the gut phase of estrogen detoxification.

## NEUROTRANSMITTERS

- **Serotonin Receptor-Memory** - You have the wild-type genotype that is associated with an improved episodic memory, which is the ability to recall details regarding personal experiences, names of people, specific events, and what exactly occurred.
- **Dopamine, Adrenaline and Estrogen-COMT** - The wild-type GG V158M genotype is associated with an improved breakdown of dopamine, adrenaline, and estrogen in response to pressure. The benefits to your genotype may be a calmer response to high-pressure situations and the ability to be more emotionally resilient in a crisis. Research has also found that your genotype had a higher threshold of pain and scored higher on social facilitation and cooperativeness.
- **Histamines and Migraines-DAO** - The wild-type CC genotype for DAO rs1049793 is associated with a reduced risk of histamine-induced migraine headaches.
- **Brain Health-PEMT** - Your genotype is associated with improved phosphatidylcholine levels for memory, anxiety, and REM sleep.
- **Glutamate-BDNF** - Your genotype is associated with improved glutamate modulation, brain repair, spatial learning, memory, and adaptability.
- **Cholesterol-APOE** - You have the ApoE e2/e3 genotype, improving cholesterol transport and the maintenance of brain neurons. The ApoE e2 allele is more protective against cognitive decline, heart disease, and is associated with a greater probability for longevity.

## ANTIOXIDANTS AND INFLAMMATION

- **Cell Protection-CAT** - Your genotype is associated with improved catalase levels, mitigating damage to your cells.
- **Glutathione-GSTM1** - You have the AG genotype that is associated with improved detoxification of benzo(a)pyrene from the burning of wood or trash, tobacco smoke, asphalt, coal, diesel exhaust, and charred meat. Your NAT2 genotype may increase or decrease this ability.
- **Glutathione-GSTP1** - While the heterozygous AG genotype for GSTP1 rs1695 is associated with a higher sensitivity to heavy metals, one advantage may be an increased VO2 max response from endurance training compared to the wild-type genotype.
- **Heavy Metals-GSTP1** - You have the wild-type CC genotype for GSTP1 rs1138272 that is associated with improved glutathione antioxidant protection against heavy metals, pesticides, and air pollution for colon, prostate, lung, throat, and fertility health. Your GSTP1 rs1695 genotype may increase or decrease this effect.
- **Glutathione-CTH** - Your genotype is associated with improved gene function, leading to adequate cysteine for glutathione production.
- **Nitric Oxide-NOS2** - Your NOS2A gene is functioning optimally for reducing the probability of age-related macular degeneration from cigarette smoke.
- **Eye Health-ARMS2** - Your genotype is associated with a lower sensitivity to the negative effects of smoking on eye health.

## DETOXIFICATION

- **Liver Enzyme-CYP1A1** - Your genotype is associated with improved detoxification of benzopyrene from cigarette smoke and will assist the function of your GSTM1 gene.
- **Liver Enzyme-THC and CYP2C9** - You have the wild-type genotype that is associated with improved metabolism of THC, the active psychoactive compound in cannabis.
- **Liver Enzyme-CYP3A4** - Your genotype is associated with normal metabolism of certain drugs that use this enzyme. We recommend further pharmacogenomic testing with your doctor for more information regarding CYP3A4.

## DNA DAMAGE, PROTECTION AND REPAIR

- **DNA Repair-MDM2** - Your MDM2 genotype is associated with improved DNA repair for sun damage if you are female.
- **DNA Repair-MLH1** - Your genotype is associated with improved DNA repair for colon, endometrium, lung, and brain protection.
- **Processed Meat and Colon Cancer-GATA3** - You have the wild-type genotype that is associated with a reduced risk of processed meat consumption and colon cancer.
- **Longevity-SIRT1** - Your SIRT1 genotype is associated with normal SIRT1 activity for longevity. While not a weakness, you may want to increase SIRT1 activity epigenetically to increase the probability of longevity, especially if you have the APOE-e4 allele. A sedentary lifestyle, aging, poor diet, and obesity lowers SIRT1 activity. Exercise, fasting, 7-8 hours of sleep per night, saunas, polyphenols, vitamin D, omega-3 fatty acids, resveratrol, magnesium, and melatonin have all been found to increase SIRT1 activity.

## CARDIOVASCULAR HEALTH AND ATHLETIC PERFORMANCE

- **Power and Recovery-ACTN3** - You have the RR genotype, associated with more Type II fast-twitch muscle fibers, an enhanced response to strength training and muscle hypertrophy, potential improved protection from eccentric training-induced muscle damage, improved training adaptation, reduced risk of sports injury, and reduced frailty risk later in life.
- **Lung Cytokines-TNFA** - If you have Asian ancestry, your genotype is associated with improved TNF-a gene function for lower inflammation in the lungs.
- **Pesticides, HDL and LDL-PON1** - You have the wild-type genotype associated with improved PON1 activity for pesticide detoxification and protection against LDL oxidation.
- **LDL-LPA** - Your genotype is associated with healthy Lp(a) levels, a sticky form of LDL that affects plaque levels.
- **Fibrinogen-ESR2** - Your genotype is associated with improved fibrinogen levels.
- **Blood Clots-F5** - Your genotype is associated with improved gene function for a lower probability of deep vein thrombosis.
- **Stress-ADRB2** - You have the wild-type GG genotype for ADRB2 rs1042713 that is associated with a lower inflammatory response on the heart from chronic stress.
- **Blood Pressure-ACE1** - Your genotype is associated with intermediate baseline ACE levels. If you are female, ACE levels may be lower. Depending on ACE2 levels, you may have a more balanced renin-angiotensin system for blood pressure.
- **Blood Pressure-ACE2** - Your genotype is associated with higher baseline ACE2, improving the balance between ACE1 and ACE2 for blood pressure, and potentially lowering the risk of COVID-19 severity. Other dietary habits and health issues could affect this result.

Genes are not your destiny - they are your blueprint. Please understand that these weaknesses can be turned into strengths based on the personalized recommendations given below. Making strategic changes to diet, environment, stressors, and even relationships can have a profound effect on optimizing gene function. Aim to turn every weakness into a strength by giving attention to the proactive, customized dietary and lifestyle modification recommendations in this section!

## DIGESTION

- **Beta Carotene to Vitamin A Conversion Rate-BCMO1** - Your BCMO1 genotype combination is associated with a reduced conversion rate of plant-based beta carotene (squash, sweet potatoes, carrots) to vitamin A. This increases your need for foods higher in vitamin A like eggs, cod liver oil, wild salmon oil and organ meats for skin, digestion, healthy eyes, lungs, and immunity.
- **ALA to EPA and DHA Conversion-FADS2** - Your genotype is associated with a reduced conversion of plant-based omega-3 ALA (walnuts, flax seeds, and pumpkin seeds) to EPA and DHA. Increased EPA and DHA intake may be needed.
- **Prebiotics, Probiotics and B12-FUT2** - The rs601338 FUT2 GG genotype has been associated with lower B12 levels in European, Indian and African populations.
- **B6-NBPF3** - You are more likely to have low B6 levels due to variants in the NBPF3 gene, increasing the sensitivity to medications that deplete B6 (oral contraceptives, antibiotics, ACE inhibitors, antacids, proton pump inhibitors and more). You need to focus on increasing foods high in B6 like wild salmon, pistachios, avocados and potatoes.
- **Adiponectin-ADIPOQ** - Your genotype is associated with lower adiponectin levels, linked to a higher probability of insulin resistance with higher red meat consumption. Strategies to increase adiponectin include coffee, omega-3 fatty acids, blueberries, almonds, strawberries, rose hip tea, chili peppers, ginger and turmeric.
- **Fat Metabolism-ACSL1** - Your genotype is associated with higher fasting glucose levels from a higher saturated fat intake. If your fasting glucose is high and you have variants in the other fat metabolism genes, fatty red meat and dairy should be reduced and more focus should be on monounsaturated and polyunsaturated fats.
- **Histamines-APB1** - You have the heterozygous TC genotype that is associated with intermediate histamine breakdown in the digestive tract. While not as impactful as the homozygous genotype, histamine sensitivity could still occur.

## METHYLATION

- **Folate-MTHFR 677** - You have the heterozygous genotype that is associated with a reduced function of approximately 30%. This increases the need for riboflavin and methylfolate for normal homocysteine levels.
- **Folate-MTHFR 1298** - You have the heterozygous genotype that is associated with a reduced function of approximately 20%. If you have a heterozygous MTHFR 1298 and a heterozygous MTHFR 677, you have a higher need for folate to maintain healthy homocysteine levels.
- **B6-CBS** - Your genotype is associated with reduced CBS gene function for homocysteine levels, gut repair, and brain health, increasing your need for B6.

## HORMONES

- **Sex Hormone Binding Globulin** - If you are female, your genotype is associated with a sensitivity to oral contraceptives and hormone replacement therapy in relation to sex hormone binding globulin (SHBG) levels for healthy hormone levels. If you are male, higher SHBG levels could affect bone mineral density and SHBG may need to be tested. However, variants may also positively lead to higher testosterone levels.

- **Vitamin D-CYP2R1** - Your genotype is associated with low circulating vitamin D levels that can affect immunity, breast health in women, and testosterone levels in men. Check your vitamin D levels and make sure you are in range.

- **Estrogen Metabolism-CYP2C19** - Individuals with the CC genotype for CYP2C19*17 are considered the normal metabolizer phenotype, which may lack the estrogen metabolism benefits of the ultra-rapid metabolizer phenotype. Please review all genes involved in estrogen metabolism for a complete picture of the process.

- **Estrogen Metabolism-CYP1A2** - For men and women with the CYP1A2 AC intermediate caffeine metabolism genotype, coffee intake was found to be less protective for breast and prostate health compared to the AA fast metabolizer.

## NEUROTRANSMITTERS

- **Serotonin Receptor-Stress** - The homozygous genotype has been associated with a reduced ability to regulate chronic stress. This may be more pronounced in females with variants in BDNF. Chronic stress may increase the susceptibility to anxiety, depression, OCD, and IBS. To mitigate perceived and chronic stress, you may require more aerobic exercise, cognitive behavioral therapy, mindfulness training, meditation, yoga, singing, prebiotics, lactobacillus helveticus, bifidobacterium longum, tryptophan, green tea, and B-vitamins.

- **Dopamine, Adrenaline and Estrogen-COMT** - The wild-type GG COMT V158M genotype is associated with a negative effect on executive function, problem-solving abilities, and mood due to lower dopamine concentrations, especially when combined with variants in the ANKK1 gene. Increasing dietary catecholamines (coffee, green tea, black tea, cacao, bananas, citrus, berries) and exercise or a job with an element of pressure and risk may increase dopamine concentrations. This may be more relevant in men due to estrogen's influence on COMT.

- **Dopamine Receptors-ANKK1** - Your genotype is associated with a lower density of dopamine receptors, reducing dopamine targets within the striatum of the brain known for rewarding feedback. Lower dopamine targets could lead to a higher likelihood of addictive behaviors, compulsive eating, and ADHD. Getting 8 hours of sleep per night, keeping your blood sugar balanced with adequate protein and fiber, high-intensity exercise, lower media exposure, vitamin D, omega-3's, and meditation all increase dopamine receptor density.

- **Anandamide-FAAH** - You have the common CC genotype that encodes for the fast activity of FAAH. This is associated with naturally lower anandamide levels that could increase anxiety, pain, pesticide sensitivity and a heightened stress response to threatening situations. You may benefit from aerobic exercise over 30 minutes (especially in altitude), CBD oil, red clover tea (women), kaempferol (raspberries, capers, cumin, cloves, almonds, cherry tomatoes, red wine), cacao, echinacea, rosemary, and hops to increase anandamide levels.

## ANTIOXIDANTS AND INFLAMMATION

- **Cell Protection-SOD2** - You have the heterozygous AG genotype for SOD2. Your mitochondria (powerhouse of the cell) may have a higher sensitivity to glyphosate, fluoridated water, chronic stress, poor sleep, and shallow breathing. Increase foods that contain manganese, lycopene, and vitamin C, milk thistle, mushrooms like reishi and cordyceps, and exercise that encourages deep breathing.

- **Glutathione-GSTP1** - You have the heterozygous AG genotype for GSTP1 rs1695 that is associated with a higher sensitivity to mercury, cadmium, arsenic, pesticides, and air pollution for breast, prostate, urinary, esophagus, and skin health. Your GSTP1 rs1138272 genotype may increase or decrease this sensitivity. Selenium, vitamin C, milk thistle, and cruciferous vegetables all assist GSTP1 gene function; however, supplemental vitamin E as alpha-tocopherol may be inflammatory.

- **Glutathione-GPX1** - Your genotype is associated with a higher need for selenium to combat oxidative stress and less tolerance to heat stress. Lower glutathione peroxidase increases the sensitivity to oxidative stress from low or high iron levels, statin drugs, thyroid damage, sun damage, and dietary or environmental lead exposure. Selenium, cold exposure, optimizing testosterone levels in men and estrogen in women, and adequate vitamin C, vitamin E, milk thistle, ginger, cumin, anise, fennel, caraway, and cardamom intake are all ways to assist GPX1.

- **Nitric Oxide-NOS1** - Your genotype is associated with a higher recommended intake of red, orange, and yellow vegetables (carrots, tomatoes, squash, corn, orange peppers, red peppers, yellow peppers, pumpkin, red beets, red onions, yellow beets, and sweet potatoes) to modulate the inflammatory process for NOS1.

## DETOXIFICATION

- **Liver Enzyme-CYP1A2** - You have the AC genotype for CYP1A2 that is associated with an increased sensitivity to heterocyclic amines (fried meat) when combined with the homozygous GSTM1 null genotype or slow acetylator NAT2 genotype. Marinades, unfiltered fermented drinks (Kombucha, beer, wine), cruciferous vegetables, parsley, and spinach have all been found to reduce the carcinogenic effect of heterocyclic amines.

- **Liver Enzyme-CYP1B1** - You have the GG genotype that is associated with reduced detoxification of polycyclic aromatic hydrocarbons (highest in vegetable oils), oral contraceptives, cigarette smoke, an increased sensitivity to excessive sun exposure, and high-dose biotin supplementation. You can assist CYP1B1 with seaweed, celery, berries, rooibos tea, red wine, and dark roast coffee.

- **Liver Enzyme-CYP2D6** - Your genotype is associated with reduced clearance of certain drugs associated with CYP2D6 rs1065852. However, more CYP2D6 SNPs are needed for a complete panel. Please talk to your doctor about further testing for CYP2D6 and drug metabolism.

- **Aromatic Amines-NAT2** - You have the slow acetylator genotype for the NAT2 gene. This is associated with reduced detoxification of aromatic amines found in tobacco smoke, commercial hair dyes, industrial and manufacturing plants, charred meat, and diesel exhaust for bladder, prostate and breast health. Cruciferous vegetables, carotenoids, and vitamin C all assist NAT2 detoxification.

- **Statins-COQ2** - Your genotype is associated with a higher likelihood of statin drug-induced muscle pain.

## DNA DAMAGE, PROTECTION AND REPAIR

- **DNA Repair-ATM** - Your genotype is associated with a higher need for folate to improve DNA repair in relation to pancreatic and breast (females) health.
- **Prostate-ESR2** - For men with the ESR2 rs2987983 homozygous GG genotype, your genotype is associated with an increased need for foods high in apigenin (celery, parsley), phytoestrogens (berries, beans, sourdough bread), milk thistle, and iodine (sea vegetables) for prostate health. All genes related to prostate health should be analyzed to better determine the cumulative value for prostate protection.
- **Breast-ESR2** - For women with the GG ESR2 rs2987983 genotype, your genotype is associated with reduced tumor suppression function for breast health. An increase in phytoestrogens including flax seeds, fermented soy for Asian women, milk thistle, and iodine (sea vegetables) may improve ESR2 gene function and tumor suppression activity. All genes related to breast health should be analyzed to better determine the cumulative value for breast protection.
- **DNA Repair-TP53** - You have the homozygous CC genotype that may be advantageous for fertility in cold climates, but also increases the need for selenium, zinc, vitamin C, reishi, and niacin for DNA repair against chemical toxicity to the thyroid gland and skin.

## CARDIOVASCULAR HEALTH AND ATHLETIC PERFORMANCE

- **Power and Recovery-ACTN3** - The RR genotype may be less beneficial for cold adaptation.
- **VO2 Max-PPARGC1A** - Your genotype is associated with a higher need for more strategies to increase oxygen capacity for aerobic exercise, including a structured endurance program, cold exposure, and adaptogens. Your genotype in the GSTP1 rs1695 gene can also influence this result.
- **Muscle Recovery-IL6** - You have the CG genotype that is associated with higher levels of creatine kinase - a marker of muscle damage - from workouts. To accelerate recovery, whey protein, cold water immersion, American ginseng, curcumin, allicin, optimal testosterone levels, vitamin C, and collagen protein have all been found to attenuate creatine kinase levels.
- **Muscle Injury-COL1A1** - You have the wild-type CC genotype that is associated with an increased need for dietary collagen for healthy skin, tendons, corneas, lungs, and bones. Vitamin C, zinc, copper, glycine, proline, lysine, and B6 are all precursors to collagen production.
- **Raw Fruit and Vegetable Intake-9p21** - You have the homozygous genotype that is associated with an increased need for phytonutrients from a higher raw fruit and vegetable intake for a healthy heart.
- **Triglycerides-FADS1** - Your genotype is associated with a higher need for EPA and DHA omega-3 fatty acids to maintain healthy triglyceride levels.
- **Potassium and Magnesium-ADD1** - If you have Asian ancestry, your genotype is associated with an increased risk of a higher sodium intake causing elevated blood pressure. Increasing potassium, vitamin D, magnesium, calcium, garlic, and omega-3's all lower blood pressure.
- **Phytoestrogens-TMPRSS2** - You have the GG genotype that is associated with a higher expression of the TMPRSS2 gene and could increase the susceptibility to viral infections and prostate issues (men). To decrease TMPRSS2 expression, increase your intake of phytoestrogens, curcumin, and lycopene.

# YOUR PERSONALIZED DNA-BASED GROCERY LIST

This section of the report represents the most expansive, actionable summary of what you can do, right now, to dramatically up-regulate gene function, building a happier, healthier you! No technical expertise is required - just make these recommendations non-negotiable when you visit the grocery store.

Your grocery list is generated based on a combination of unique gene variants that require an increased intake of the following vitamins, minerals, phytonutrients, amino acids, fiber and more. This list generates the foods and drinks based on the highest levels for each section and does not take into account any food allergies or sensitivities.

**B12**

Seafood, meat, dairy (if consuming dairy) and unfiltered fermented drinks

**B2**

Lamb, salmon, yogurt, liver and oyster mushrooms

**B6**

Wild salmon, yellowfin tuna, liver, chicken breast, unfiltered fermented drinks, pistachios, avocado, sweet potatoes, and spinach

**Beta-Carotene**

Sweet potatoes, carrots, spinach, squash, cantaloupe, and broccoli

**Boron**

Prunes, avocados, raisins, peaches, apples, pears, and peanut butter

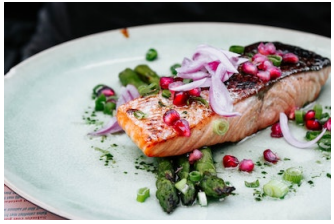
**Folate**

Collard greens, beets, black-eyed peas, raw spinach, asparagus, hummus, broccoli, romaine lettuce, parsley, liver, strawberries, oranges, and sprouted lentils

**Glycine**

Broth, collagen powder, meat with the skin, ribs, shanks, drumsticks, and baobob

| | | |
|---|---|---|
|  | **Lycopene** | Tomato sauce, whole tomatoes, guava, and watermelon |
|  | **Manganese** | Mussels, wild blueberries, hazelnuts, pecans, oysters, clams, hummus, spinach, and cultivated blueberries |
|  | **Niacin** | Yellowfin tuna, canned tuna, wild salmon, ground turkey, chicken breast, liver, skirt steak, white button mushrooms, and brown rice |
|  | **Omega-3's** | Seafood and pastured eggs |
|  | **Phytoestrogens** | Dark berries, beans, sourdough bread, hummus, peanuts, miso soup, flax seeds (women), tahini sauce, and cruciferous vegetables (broccoli, cabbage, kale, Brussels sprouts) |
|  | **Polyphenols** | Coffee, green tea, kombucha, blueberries, strawberries, raspberries, blackberries, and cacao |
|  | **Potassium** | Wild salmon, avocados, potatoes, acorn squash, coconut water, sweet potato, spinach, tomato sauce, and bananas |
|  | **Selenium** | Oysters, pork chops, beef, chicken breast, shrimp, eggs, shiitake mushrooms, and whole grain sourdough bread |
|  | **Vitamin A** | Liver, pastured eggs, cod liver oil, wild salmon oil, eel, and sockeye salmon |



| | |
|---|---|
| **Vitamin D** | Sockeye salmon, cod liver oil, canned tuna, wild herring, and sardines |

# PERSONALIZED BLOOD WORK

These results are generated based on a combination of gene variants unique to you. These biomarkers may not be out of range based on your diet and lifestyle habits, but they may be the ones for you to monitor to ensure you are making the right choices based on your genetic results (your predispositions).

For example, if vitamin D comes up in this section, it does not mean that your current levels of vitamin D are actually low. What we are saying is that based on a variety of genetic factors, your variants could make it more difficult to obtain recommended levels of circulating vitamin D, so it might be prudent to further monitor to ensure that you are taking the necessary steps to turn genetic weaknesses into strengths and maintain correct levels.

**Adiponectin**

Check for low levels of adiponectin

**B12**

If poor B12 status is suspected, methylmalonic acid (MMA) levels may be needed to accurately assess B12 status, absorption, and requirements

**B6**

B6 levels may need to be tested

**Fasting Glucose and HbA1C**

Check both fasting glucose and HbA1C

**Homocysteine**

Homocysteine should be between 7-9

# HORMONE SUPPORT

## Sex Hormone Binding Globulin

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| SHBG rs12150660 | Heterozygous TG |
| SHBG rs1799941 | Heterozygous AG |

### Recap

Improves SHBG Gene Function for Women: SHBG levels that are too low will benefit from a high-fiber, low-fat diet, coffee, no sugar, and exercise 3-5 times a week. SHBG levels that are too high may be caused from SHBG variants combined with estrogen therapy (oral contraceptive or hormone replacement therapy). Improves SHBG Gene Function and Testosterone for Men: Magnesium, zinc, vitamin D, fish or fish oil, boron, adequate protein and a higher healthy fat intake (if testosterone is low and other fat genes are working optimally).

Decreases SHBG Gene Function for Men and Women: Anorexia, fatty liver, obesity, Type 2 diabetes, high fructose corn syrup, agave and crystalline fructose.

SEX HORMONE BINDING GLOBULIN

**Research Women**: Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. Serum levels of SHBG are influenced by hormonal as well as nutritional and metabolic status.

In a study of Italian women free of diabetes, serum SHBG levels showed a U-shaped trajectory with age, declining from age 20 to age 60, and increasing after the age 60 progressively after each decade. These changes mirror the age-related changes in BMI and fasting insulin, suggesting that BMI and insulin negatively influence SHBG concentration.

The SHBG levels in AA homozygotes for rs1799941 were 39% higher than in GG homozygotes in post-menopausal women. Subjects with the A allele (GA+AA) for rs1799941 had a trend for lower free estradiol index compared to the GG genotype. They also had a significantly lower bone mineral density (BMD) at the intertrochanter of the hip and trend for lower BMD at the total hip.

Changes in SHBG concentration will also affect the levels of bioavailable testosterone in women. Elevations in estradiol (as occurs during pregnancy), oral contraceptives, hormone therapy, anorexia and hyperthyroidism cause a marked increase in SHBG levels with a subsequent decrease in serum free testosterone levels. Levels of SHBG that are too high could affect mood, lean muscle mass, bone strength and sex drive.

Hypothyroidism, Type 2 diabetes, fatty liver and obesity are associated with SHBG levels that are too low, and therefore very low SHBG can be a biomarker for these disorders. A low-fat and high-fiber diet alone or combined with exercise reduces insulin, BMI levels and increases SHBG levels.

**Research Men**: Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. Serum levels of SHBG are influenced by hormonal as well as nutritional and metabolic status. In men, SHBG levels increase with age as testosterone levels decline.

Only a small fraction of the total testosterone - from 1% to 2% - is free in the blood and biologically active. About 40% to 70% of total testosterone travels around with SHBG and may not available to your cells. This means a large part of total testosterone may not be biologically active and available to your cells if SHBG is too high even though your testosterone is in a healthy range.

One study showed that serum SHBG concentration is increased in middle-aged men with primary or secondary osteoporosis and is correlated with bone remodeling markers, hip bone mineral density, and vertebral fracture risk. Serum SHBG level was significantly higher (+42.2%), whereas free androgen index was lower (-24.8%) in patients with primary or secondary

osteoporosis. Testosterone and estradiol levels did not correlate with any bone resorption or bone formation markers for men. Another study found that osteoporotic Chinese men had lower free testosterone (FT) and higher levels of SHBG.

You can also go too far in the other direction. A study of men in the U.S indicated that men with lower concentrations of total testosterone and SHBG had a higher likelihood of having metabolic syndrome than those with higher concentrations.

The associations of rs12150660 and rs6258 were confirmed in the three replication cohorts showing that men with the GT and TT genotype for rs12150660 had higher levels of testosterone, free testosterone, and SHBG, while the TC genotype for rs6258 had lower testosterone, calculated free testosterone and SHBG compared to the wild-type CC genotype. Not enough subjects had the homozygous TT genotype to produce data.

The rs6258 SHBG gene was found to substantially affect SHBG binding affinity by lowering free testosterone levels. The lowest testosterone levels were found in those with the GG genotype of rs1210660 and the TC or TT genotype of rs6258. Therefore variants in rs12150660 may benefit free testosterone levels even though SHBG is higher, however this may depends on your rs6258 genotype.

Another study found that individuals with the AA genotype for rs1799941 were associated with decreased sperm motility compared to GG genotypes. Research has found that vitamin C supplementation might improve sperm count, sperm motility, and sperm morphology.

## Vitamin D-CYP2R1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP2R1 rs10741657 | Heterozygous AG |

### Recap

Improves CYP2R1 Gene Function: Sun exposure, adequate vitamin D intake and vitamin D co-factors.

Decreases CYP2R1 Gene Function: Lack of sun exposure, high fructose intake and lack of vitamin D co-factors.

VITAMIN D-CYP2R1

**Research**: Studies confirm that CYP2R1 is the principal 25-hydroxylase in humans and demonstrates that CYP2R1 alleles have dosage-dependent effects on vitamin D homeostasis.

A 2018 meta-analysis of sixteen articles with a total of 52,417 participants was reviewed for rs10741657. The GG genotype was associated with a clear descending trend of 25(OH)D levels when compared with the AA genotype in Caucasian and Asian populations.

Research has shown that oral administration of vitamin D led to negligible increases in serum 25-hydroxy-vitamin D for homozygotes, and significantly lower increases in serum 25-hydroxy-vitamin D in heterozygous subjects than in control subjects. The heterozygous effect may only be relevant in Caucasian populations.

Vitamin D can influence the expression of more than 1,000 genes and vitamin D deficiency has been linked to fatty liver, seizures, infertility, osteoporosis, cancer, autism (mother deficient), depression, heart attacks, Alzheimer's, dementia, high blood pressure, low testosterone in men, autoimmune disorders and more.

The literature is mixed on optimal vitamin D levels, which most likely vary based on your heritage, skin color and current health issues. The most well documented cause of Vitamin D deficiency is inadequate sunlight exposure such as high latitude countries. Paradoxically, despite its high sunlight hours, vitamin D deficiency is well recognized in Middle Eastern women, inner city young adults in America, athletes and dancers in Israel, elite gymnasts in Australia, young Hawaiian surfers, and adolescent girls in England.



For athletes, vitamin D deficiency has long been associated with muscle weakness and suboptimal muscle function. A positive

relationship between serum vitamin D level and jump height, jump velocity and power was found in young women.

Clinical vitamin D deficiency is below 20 ng/ml. There is little evidence to prove there is a benefit for levels above 50 ng/ml. The latest cancer research has found that women with 25(OH)D concentrations greater than 40 ng/ml had a 67% lower risk of cancer than women with concentrations less than 20 ng/ml. Pesticides have been linked to suppressing vitamin D levels and creating a vitamin D deficiency. Your PON1 gene function should also be assessed.

Research has found that sunlight is the optimal way to optimize vitamin D levels along with exercise, vitamin D rich foods and vitamin D cofactors, however supplementation may be necessary.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SHBG<br>Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. | SHBG-rs12150660 | | TG | |
| | SHBG-rs1799941 | | AG | |
| SHBG<br>Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. Variants in this gene have been shown to lead to lower testosterone, calculated free testosterone and SHBG in men. | SHBG-rs6258 | CC | | |
| DI01<br>DI01 is connected to thyroid health and is responsible for the deiodination of T4 into T3. | DI01-rs2235544 | | AC | |
| DI02<br>DI02 is connected to thyroid health and is responsible for the deiodination of T4 into T3. D2 is the only activating deiodinase in the brain. | DI02-rs225014 | TT | | |
| CYP2R1<br>Vitamin D is technically a hormone, and CYP2R1 is connected to circulating vitamin D levels. | CYP2R1-rs10741657 | | AG | |
| CYP1A1<br>CYP1A1 is in the estrogen metabolism pathway along with CYP1B1, CYP1A2, CYP31A, SULT's and COMT. | CYP1A1-rs1048943 | TT | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CYP2C19*17<br>Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens. | CYP2C19*17-rs12248560 | CC | | |
| CYP1A2<br>CYP1A2 is a key enzyme in caffeine metabolism and the 2-hydroxylation of the main estrogens, estrone, and estradiol. | CYP1A2-rs762551 | | AC | |
| COMT<br>COMT is involved in catecholamine, dopamine, adrenaline, and estrogen metabolism through the inactivation of the catechol estrogens. | COMT-rs4680 | GG | | |
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption, and how much bifidobacteria you carry in your digestive tract. | FUT2-rs601338 | GG | | |
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption, and how much bifidobacteria you carry in your digestive tract. The FUT2 gene rs1047781 (A385T) has been shown to be a potential functional variant associated with vitamin B12 status and a major FUT2 secretor defining SNP in East Asians. | FUT2-rs1047781 | AA | | |

# MACRONUTRIENT METABOLISM

## Beta Carotene to Vitamin A Conversion Rate-BCMO1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| BCMO1 A379V rs7501331 | Wild Type CC |
| BCMO1 R267S rs12934922 | Heterozygous AT |

Recap

Improves BCMO1 Gene Function: Vitamin A in the form of retinol and zinc.

Decreases BCMO1 Gene Function: Relying on beta-carotene for vitamin A requirements.

BETA CAROTENE TO VITAMIN A CONVERSION RATE-BCMO1

**Research**: If you are heterozygous or homozygous for BCMO1 A379V or BCMO1 RS267S, you have a reduced conversion of beta-carotene to vitamin A. If you have a heterozygous or homozygous BCMO1 RS267S and BCMO1 RS267S, the reduction is even more dramatic. Many nutrition labels will have beta-carotene listed as vitamin A, however this is not true vitamin A.

The normal conversion for beta-carotene (carrots, sweet potatoes) to retinol is 1:6 and 1:12 for other carotenoids. Female volunteers carrying the T variant of rs7501331 (379V) had a 32% lower ability to convert beta-carotene, and those carrying at least one T in both SNPs (379V and R267S) show a 69% lower ability to convert beta-carotene into retinol.

In a cohort study of 48,400 US men and 75,170 US women, during a follow-up period of more than 26 years, a higher total vitamin A intake was associated with a reduction in cutaneous squamous cell carcinoma risk.

You want to make sure you consume animal based vitamin A (pastured egg yolks, wild salmon oil, cod liver oil, butter) along with zinc for digestive lining repair, oral health, eye health, iron mobilization, mitochondria health, skin health (sunburns deplete vitamin A in the skin, and acne responds to vitamin A), healthy lung function, and increased immunity.

## ALA to EPA and DHA Conversion-FADS2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| FADS2 rs1535 | Heterozygous AG |
| FADS2 rs174575 | Heterozygous CG |

Recap

Improves FADS2 Gene Function: EPA and DHA omega-3 fatty acids.

Decreases FADS2 Gene Function: Relying on plant-based omega-3 fatty acid ALA for those with the heterozygous or homozygous variant.

ALA TO EPA AND DHA CONVERSION-FADS2

**Research**: You may have a decreased conversion rate of the plant based omega-3 fatty acid ALA to DHA and should choose DHA sources for sufficient omega-3's.

FADS1 and FADS2 are enzymes that are involved in converting omega-3 and omega-6 fatty acids for brain development and inflammation control. Like the lactase gene, FADS1 is likely to be a critical gene of adaptation. In this case, it was in response to a plant-based diet versus a meat and fish based diet depending on migration routes and food availability.

It has been hypothesized that populations that began to rely more on plant-based diets adapted with the selected allele in FADS2 to synthesize more EPA and DHA from plants. The Inuit populations of Greenland, for example, who rely heavily on seafood with very little plant intake, have a deleted allele showing an opposite adaptation to a diet without plants.

A meta-analysis has found an association between variants in FADS2 in European heritage and a low conversion rate of ALA (plant-based omega-3) to DHA. There is also evidence for gene variants in those with African, Chinese, and Hispanic ancestry having a reduced conversion rate.

Children who had a higher dietary ratio of omega-6 to omega-3 were vulnerable for developing colitis if they also presented specific variants in FADS2.

A higher need of animal-based EPA and DHA may be needed for those with variants in FADS2.

## B6-NBPF3

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| NBPF3 rs4654748 | Heterozygous TC |

Recap

Improves NBPF3 Gene Function: B6

Decreases NBPF3 Gene Function: Sugar, stress, high intake of alcohol and refined flour based carbohydrates, antibiotics, oral contraceptives, ACE inhibitors, antacids, proton pump inhibitors, Phenytoin, bronchodilators, Digoxin, diuretics, hormone replacement therapy, Estradiol, MAO inhibitors, St. John's Wort and Parnate.

B6-NBPF3

**Research**: You may require a higher intake of B6. Heterozygotes (TC genotype), have a 1.45 ng/mL lower Vitamin B6 blood concentration than the wild-type genotype.

Vitamin B6 plays a major role in neurotransmitter health. B6 deficiency can manifest as anorexia, irritability, anxiety, depression, muscle pain, bad PMS/low progesterone, nausea, seizures, migraines, dermatitis, age related macular degeneration (with low folate and B12) and lethargy.

Researchers have found an inverse association between ovarian cancer risk and vitamin B6 intake. Subjects with the highest vitamin B6 intake showed a 24 percent decrease in the likelihood of developing ovarian cancer compared to the individuals with the lowest intake.

Women of reproductive age, especially current and former users of oral contraceptives, teenagers, male smokers, non-Hispanic African-American men, and men and women over age 65 are most at risk of B6 deficiency. Data suggests that oral contraceptive users have extremely low plasma PLP levels. Three quarters of the women who reported using oral

contraceptives, but not vitamin B6 supplements, were vitamin B6 deficient.

## Adiponectin-ADIPOQ

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ADIPOQ rs2241766 | Heterozygous TG |

### Recap

Improves ADIPOQ Gene Function: Exercise, weight loss, low red meat consumption (depending on weight and ethnicity), intermittent fasting, omega-3 fatty acids, pterostilbene, coffee, tiliroside, berberine, chili peppers, ginger and curcumin.

Decreases ADIPOQ Gene Function: Sedentary lifestyle, obesity, high red meat consumption (depending on weight and ethnicity), and smoking.

ADIPONECTIN-ADIPOQ

**Research**: Adiponectin is released by adipose (fat) tissue and is known as an insulin-sensitizing hormone, which can increase the effect of insulin and improve glucose metabolism. Decreased levels of adiponectin have been found in people with obesity, Type 2 diabetes, heart disease and ADHD.

Approximately 2,511 variations have been identified in the human ADIPOQ gene, including rs2241766 that has been associated with breast, colon, gastric, hepatocellular, prostate and endometrial health in different populations. A genome-wide association study (GWAS) revealed that the ADIPOQ gene could explain 6.7% of the phenotypic variance for plasma adiponectin.

Studies have found that carriers of the ADIPOQ rs2241766 TG and GG genotype are more likely to be associated with lower adiponectin, higher insulin resistance, heart disease and potentially colon cancer risk based on gender and ethnicity compared with those carrying the TT genotype.

A 2017 meta-analysis of 35 studies found that rs2241766 was linked to an increased risk of coronary heart disease development. A second 2017 meta-analysis of twelve case control studies found that variants in ADIPOQ rs2241766 was correlated with colon cancer risk, especially in cases of insulin resistance with rs2241766 in Ashkenazi Jewish and Chinese populations. A 2015 study found that "ADIPOQ rs2241766 and rs1501299 could be associated with colorectal pathogenesis and could have interactions with red meat intake" in the Chinese population.

Research has shown that a high intake of unprocessed and processed red meat intake was associated with higher plasma CRP, ferritin, fasting insulin, HbA1c and lower adiponectin levels. However, when adjusted for BMI (body mass index), inflammatory and glucose metabolic biomarkers were substantially attenuated and no longer significant.

Accumulating literature had suggested that adiponectin plays a role in the pathophysiology of gestational diabetes. A study of Malaysian women found a significant association with the TG genotype and gestational diabetes. In addition, normal patients with the wild-type TT genotype had significantly higher plasma adiponectin level compared to other groups.

In women, higher red and processed meat consumption has been significantly associated with a higher CRP and lower adiponectin levels. When stratified for ethnicity, significantly associations of red and processed meat intake and lower adiponectin levels were observed only in African Americans and Latinas, but not in Japanese Americans, Native Hawaiians or whites.

Research has shown a significant increase in plasma adiponectin concentrations in human obese subjects after a 3-month treatment with the omega-3 fatty acid EPA (1.8 g daily), showing one pathway in which omega-3 fatty acids protect against heart disease.

One study found that pterostilbene (blueberries, mulberries, cranberries, raw almonds) demonstrated antiobesity properties by upregulating adiponectin and downregulating leptin.

Another study evaluated the effect of tiliroside (rose hips, strawberries, raspberries) in obese, diabetic mice and found that that plasma insulin, free fatty acid and triglyceride levels were decreased, and plasma adiponectin levels were increased.

One study found that berberine reduces TNF-□ and leptin expression levels, while adiponectin was increased by 35% after treatment of berberine.

A mice study found that capsaicin, a compound in hot peppers, decreased levels of IL-6 and increased the level of adiponectin released from obese fat tissues and fat cells.

In breast cancer patients, both 750mg of ginger daily and swimming 4x a week increased adiponectin, nitric oxide, and glutathione peroxidase.

In a randomized, double-blind, placebo-controlled trial in human subjects, curcumin from the spice turmeric, improved serum levels of adiponectin and leptin in patients with metabolic syndrome.

## Fat Metabolism-ACSL1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| ACSL1 rs9997745 | Wild Type GG |

### Recap

Improves ACSL1 Gene Function: Total fat intake under 35%, lower saturated fat intake and increased PUFA intake.

Decreases ACSL1 Gene Function: A saturated fat intake over 35%.

FAT METABOLISM-ACSL1

**Research**: If you have the GG genotype, it may be beneficial for fat intake to be below 35% of your total calories or have a higher intake of polyunsaturated fat from fish, nuts and seeds if you struggle with weight and high glucose.

The GG genotype had higher fasting glucose and insulin concentrations compared with the minor A allele carriers from saturated fat intake, with the result that the GG genotype were more insulin resistant. Among individuals within the top 50th percentile of PUFA intake, the metabolic syndrome risk associated with GG homozygosity was eliminated.

Foods that are higher on the insulin index include dairy and red meat, and insulin inhibits fat breakdown. Fat should come primarily from nuts, seeds, olive oil, avocados, poultry and fish if there are issues with fasting glucose, insulin or weight.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| BCMO1 A379V<br>BCMO1 encodes the conversion rate from beta-carotene to vitamin A. | BCMO1 A379V-rs7501331 | CC | | |
| | BCMO1 R267S-rs12934922 | | AT | |
| FADS2<br>The FADS2 gene encodes the conversion of plant based omega-3 fatty acid alpha linolenic acid (ALA) to EPA. | FADS2-rs1535 | | AG | |
| | FADS2-rs174575 | | CG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption and how much bifidobacteria you carry in your digestive tract. The rs601338 SNP is found in European, African and Indian populations. | FUT2-rs601338 | GG | | |
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption, and how much bifidobacteria you carry in your digestive tract. Variants in the rs1047781 FUT2 SNP are found in the East Asian populations. | FUT2-rs1047781 | AA | | |
| NBPF3<br>NBPF3 has been associated with vitamin B6 levels. | NBPF3-rs4654748 | | TC | |
| SLC23A1<br>Solute carrier family 23 member 1 (SLC23A1) is one of the two transporters which aids in the absorption of vitamin C into the body. Polymorphisms in the gene are associated with reduced plasma vitamin C levels in the body. | SLC23A1-rs33972313 | CC | | |
| ACAT1-02<br>The ACAT gene converts protein and fat to ATP (energy) in the mitochondria, and plays an important role in cellular cholesterol homeostasis. | ACAT1-02-rs3741049 | GG | | |
| ADIPOQ<br>ADIPOQ encodes for adiponectin, a protein secreted by fat cells that affect insulin and glucose metabolism. Low levels of adiponectin play a role in obesity, insulin resistance and Type 2 diabetes. | ADIPOQ-rs2241766 | | TG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| HFE-C282Y<br>A homozygous HFE C282Y may lead to an iron overload due to increased iron absorption and disrupted metabolism. | HFE-C282Y-rs1800562 | GG | | |
| HFE-C282Y<br>A heterozygous HFE C282Y and HFE H63D gene may lead to an iron overload due to increased iron absorption and disrupted metabolism. | HFE-C282Y-rs1800562 | GG | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SLC22A5<br>L-Carnitine is responsible for shuttling fats into your cells, modulating your lipid profile, glucose metabolism, oxidative stress, fat loss and inflammatory responses in the mitochondria. | SLC22A5-rs1045020 | CC | | |
| | SLC22A5-rs17622208 | | AG | |
| | SLC22A5-rs2073643 | | TC | |
| | SLC22A5-rs274549 | | | CC |
| | SLC22A5-rs274550 | | | TT |
| | SLC22A5-rs274551 | | | CC |
| | SLC22A5-rs274570 | CC | | |
| | SLC22A5-rs274558 | AA | | |
| | SLC22A5-rs274557 | TT | | |
| | SLC22A5-rs17689550 | CC | | |
| | SLC22A5-rs274567 | CC | | |
| | SLC22A5-rs671473 | CC | | |
| | SLC22A5-rs2631359 | CC | | |
| | SLC22A5-rs4646301 | GG | | |
| | SLC22A5-rs274571 | AA | | |
| | SLC22A5-rs635619 | GG | | |
| | SLC22A5-rs2073642 | CC | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| PPAR-alpha<br>The PPAR-alpha gene plays a vital role in fatty acid metabolism and ketosis, and is considered one of the most critical targets for ameliorating abnormalities with triglycerides, HDL, LDL, VLDL, and ApoB. | PPAR-alpha-rs1800206 | CC | | |
| ACSL1<br>Long-chain acyl CoA synthetase 1 (ACSL1) plays an important role in fatty acid metabolism and triglyceride synthesis. Disturbance of these pathways may result in dyslipidemia and insulin resistance, hallmarks of the metabolic syndrome. | ACSL1-rs9997745 | GG | | |
| FTO<br>Polymorphisms in the FTO genes have been shown to cause higher ghrelin levels (hunger hormone) in many populations, which can create a larger appetite and the potential for overeating. | FTO-rs9939609 | | AT | |
| | FTO-rs17817449 | | TG | |
| APOA2<br>The APOA2 gene contains instructions for making a protein called apolipoprotein A-II, which is found in HDL cholesterol particles. The homozygous genotype has been linked to saturated fat intake and weight gain. | APOA2-rs5082 | | AG | |
| TCF7L2<br>TCF7L2 polymorphisms have been associated with low incretin hormones and impaired insulin secretion. | TCF7L2-rs7903146 | CC | | |
| LCT<br>LCT is the gene connected with the ability to breakdown lactose in dairy. | LCT-rs4988235 | | | AA |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| APB1<br>APB1 is encodes for the DAO enzyme to breakdown histamines primarily in the digestive tract. The homozygous genotype may increase the risk of migraines from histamines in women or a hypersensitivity to Aspirin in men. | APB1-rs10156191 | | TC | |
| ABCG2 (Q141K)<br>The ABCG2 (Q141K) gene is located at the membrane of kidney proximal tubule cells, where it mediates renal urate secretion. Variants in this gene are linked to reduced uric acid excretion. | ABCG2 (Q141K)-rs2231142 | GG | | |
| ALDH2<br>Alcohol metabolism in the liver most commonly involves the enzymes alcohol dehydrogenase and aldehyde dehydrogenase, metabolizing alcohol to acetaldehyde, and then to acetate. ALDH2 encodes for aldehyde dehydrogenase, and variants can affect the levels of acetaldehyde and therefore the carcinogenic effect of alcohol. | ALDH2-rs671 | GG | | |

# INFLAMMATION & ANTIOXIDANT PROTECTION

## Cell Protection-SOD2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| SOD2 rs4880 | Heterozygous AG |

### Recap

Improves SOD2 Gene Function: Manganese, boron, vitamin A, C, E, omega-3 fatty acids, CoQ10, lutein, lycopene, milk thistle, cordyceps, holy basil, reishi and cryotherapy.

Decreases SOD2 Gene Function: Glyphosate, fluoridated water, chronic stress, poor sleep, shallow breathing, high iron levels and food dyes.

CELL PROTECTION-SOD2

**Research**: SOD2 is superoxide dismutase, which protects against the inflammatory superoxide inside the cell for the mitochondria (power house of the cell). SOD2 is manganese dependent, and adequate intake is important. Manganese is crucial for heart health, blood sugar, male fertility, bone health and protecting the brain against glutamate toxicity.

Exercise also helps improve SOD2 activity. Studies show exercise intensity can reduce cardiac arrhythmias and myocardial infarction due to improved SOD2 function.

Glutathione level and activity of antioxidant enzymes (catalase, superoxide dismutase, glutathione peroxidase and glutathione reductase) have been found to be increased in yoga practitioners. One year of Tai Chi training has been reported to promote superoxide dismutase activity and lessen lipid peroxidation.

One study found that young men exposed to cryotherapy for 3 minutes at -202°F (-130°C) everyday for 20 days doubled the activity of one the antioxidant enzyme glutathione reductase, and increased superoxide dismutase by 43%.

Chronic stress, poor sleep, shallow breathing and food dye consumption are examples of ways intracellular inflammation can occur. Food dyes have been found to inhibit mitochondrial respiration; the ability of the powerhouse of your cells to convert nutrients to energy and food dyes are often used ironically in sports drinks and multivitamins.

Fluoride decreases SOD2 activity in studies, and 75% of the water in the U.S. is fluoridated compared to 3% of western Europe. Reverse osmosis systems remove fluoride from water.

Variants in SOD2 increase the need for manganese to protect the mitochondria and lactobacillus in the gut. Colitis has been linked to impaired SOD2 genes.

Vitamin, A, C, E, omega-3 fatty acids, cordyceps and reishi help protect mitochondria against intracellular superoxide in red blood cells.

## Glutathione-GSTP1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| GSTP1 I105V rs1695 | Heterozygous AG |

Recap

Improves GSTP1 Gene Function: Glycine, cysteine, selenium, vitamin C, B1, B6, zinc, magnesium, optimal iron levels, magnesium, alpha lipoic acid, milk thistle, holy basil and vitamin E supplementation for the homozygous GG genotype only.

Decreases GSTP1 Gene Function: Mercury, arsenic, cadmium, pesticides, and air pollution.

GLUTATHIONE-GSTP1

**Research**: Glutathione is the master antioxidant system involved in oxidative stress, detoxification and immunity. It requires the amino acids glycine, cysteine and glutamate. Selenium activates the glutathione system and works in concert with vitamin E as a potent antioxidant against plasma and LDL lipid peroxidation.

The functional polymorphism of the GSTP1 Ile105Val gene, which reduces enzymatic activity, involves an A-G substitution. Carriers of these mutations are less able to detoxify carcinogens, and epidemiological studies have suggested that individuals differing in the expression of allelic variants of GSTP1 gene differ in susceptibility to various chemical carcinogens.

A meta-analysis of 10,067 cancer cases and 12,276 controls in 41 independent case–control studies from 19 articles found a significant increase in risk in breast cancer in Caucasions with variants in GSTP1 rs1695. A second meta-analysis found the same results with Asians that had the GG genotype. A 2020 study found that the rs1695 homozygous GG genotype was associated with an increased risk of breast cancer, but not the AG genotype. Other research has shown the risk to be higher in premenopausal women vs. post-menopausal women.

An analysis of that included 3,035 breast cancer cases and 3,037 population controls in a Chinese population found that cruciferous vegetable intake helped offset the risk of the GG genotype, with a lower risk associated with a higher cruciferous vegetable intake.

A meta-analysis of 11,762 cases and 15,150 controls from 51 studies showed a statistically significant association between GSTP1 rs1695 polymorphism with prostate cancer risk and urinary system cancer among Asians.

GSTP1 rs1695 variants were reported to be associated with the risk of esophageal cancer and malignant melanoma in the Caucasian population, but not childhood acute lymphoblastic leukemia or bladder cancer.

Glutathione-related polymorphisms, such as GSTM1 and GSTP1 have also been found to increase the elevation and toxicity of mercury. Selenium blocks mercury uptake, folate decreases mercury levels and magnesium and holy basil protect against mercury toxicity.

One benefit of the GSTP1 AG and GG genotype appears to be in athletic training. GSTP1 rs1695 AG and GG may be high responders to endurance training due to an impaired ability to remove excess reactive oxygen species. The hypothesis is that better activation of cell signaling pathways results in positive muscle adaptations. Women with at least one copy of the G allele showed a significantly greater increase in V?O2max in response to applied training.

In healthy control subjects, the effect of a-tocopherol supplementation on the production of inflammatory cytokines appears to be dependent on an individual's GSTP1 rs1695 genotype. These genotype-specific differences may help explain some of the discordant results in studies that used vitamin E. Persons having the alleles AA or AG in GSTP1 rs1695 had an increase in inflammatory interleukin-6 (IL-6) upon supplementing alpha-tocopherol (the most common form of Vitamin E in a North American diet) while those with GG saw a decrease.

## Glutathione-GPX1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| GPX1 rs1050450 | Heterozygous AG |

Recap

Improves GPX1 Gene Function: Selenium, optimal testosterone and estradiol levels, melatonin, vitamin C, vitamin E, black cumin seed oil, flavonoids, milk thistle, ginger, cumin, anise, fennel, caraway, cardamom and cryotherapy.

Decreases GPX1 Gene Function: Selenium deficiency, statin drugs, iron deficiency or elevated iron, and lead.

GLUTATHIONE-GPX1

**Research**: Superoxide dismutase (SOD) transforms the inflammatory superoxide to hydrogen peroxide (H2O2), and the next step is for glutathione peroxidase (GPX1) to transform it to water (H2O). When GPX1 function is modulated by polymorphisms and other factors affecting its function, a hydroxyl radical may be more likely to form which attacks DNA and causes strand breaks.

Research has shown that there is reason to believe that individual requirements for selenium will differ because of polymorphisms in seleno-protein genes. In a study looking at a New Zealand population, homozygous minor allele carriers of GPX1 rs1050450 had lower GPX1 activity than other genotypes with the same selenium status.

Elevated lead levels may have more toxic effects with GPX1 polymorphisms. A study looking at 362 patients and 494 controls found that lead exposure and GPX1 polymorphisms were significantly associated with glioblastoma and meningioma. Vitamin C decreases blood lead levels, and calcium reduces lead uptake.

GPX1 activity is considered to be the most important antioxidant enzyme defense mechanism in the skin. In a study from the Journal of Dermatological Science, the homozygous genotype for GPX1 rs1050450 was associated with a a two-fold increased risk of melanoma.

Statins inhibit the biosynthesis of selenium containing proteins, one of which is glutathione peroxidase serving to suppress peroxidative stress. An impairment of selenoprotein biosynthesis may be a factor in congestive heart failure, reminiscent of the dilated cardiomyopathies seen with selenium deficiency. A meta-analysis found that East Asian populations may be prone to cardiovascular issues with GPX1 polymorphisms.

Oxidative stress and inflammation play a pivotal role in the pathogenesis of Hashimoto's disease, an autoimmune disorder. A study looking at patients in Northwest Iran found that antioxidant capacity in Hashimoto's patients was lower than healthy controls. There was also a significant association with variants in GPX1 rs1050450, elevated anti-TPO levels, and Hashimoto's risk. The thyroid is the organ with the highest amount of selenium per gram of tissue. Research has suggested that selenium supplementation of patients with Hashimoto's disease is associated with a reduction in anti-TPO levels, improved thyroid ultrasound features, and improved quality of life.

In an experiment investigating the effect of heat and cold stress on glutathione metabolism in human erythrocytes, men were immersed at three different water temperatures for 10 min. At 39 degrees C (102 F), glutathione peroxidase decreased from 35.90 (1.83) to 34.33 (1.66) IU.g. The researchers concluded that "these changes indicate that heat stress causes oxidative stress in the human body; however, cold stress is thought to augment the activity of the antioxidative defense system. It is suggested that body exposure to hot environmental conditions should not be recommended for patients suffering from a damaged antioxidative defense system."

One study found that elite kayakers that engaged in whole body cryotherapy (-248 to 284°F or -120 to 140°C) for 3 minutes a day for 10 days increased the activity of superoxide dismutase by 36% and glutathione peroxidase by 68%.

## Nitric Oxide-NOS1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| NOS1 rs545654 | Wild Type CC |
| NOS1 rs7298903 | Wild Type TT |
| NOS1 rs3782218 | Homozygous TT |

## Recap

Improves NOS1 Gene Function: Carotenoids, polyphenols and DHA.

Decreases NOS1 Gene Function: Psychological stress and pesticides.

NITRIC OXIDE-NOS1

**Research**: Nitric oxide acts as a neurotransmitter, neuromodulator, vasodilator, anti-microbial, ant-tumorigenic, insulin secretions, peristalsis, inhibiting calcium entry into the cell, increasing potassium channels, and decreasing intracellular calcium.

NOS1 has a role in the regulation of the serotonin pathway, the HPA axis, and psychological stress. Chronic stress increases NOS1 expression in many parts of the brain, including the hippocampus (affecting emotion and memory). Recent studies have reported gene-specific and global changes in DNA methylation in response to psychological stress in humans. Chronic psychosocial stress has been associated with accelerated aging at the cellular level including shortened telomeres, low telomerase activity, decreased antioxidant capacity, and increased oxidative stress.

Variants in NOS1 may benefit from balancing the HPA axis (primary stress response system) and polyphenol consumption. There is considerable evidence showing that cellular oxidative damage occurring in Parkinson's disease might result also from the actions of altered production of nitric oxide. Polyphenols modulate neuroinflammation by inhibiting the expression of inflammatory genes and the level of intracellular antioxidants.

NOS1 also plays a role in oxidative stress and cancer prevention. For oxidative stress, interactions were found between pesticides, SOD3, and the NOS1 SNPs rs12829185, rs1047735, and rs2682826. The foods correlated in research to improved NOS1 function include carrots, tomatoes, squash, corn, orange peppers, red peppers, yellow peppers, pumpkin, red beets, red onions, yellow beets, and sweet potatoes to offset oxidative stress. One study found that carriers of the variant allele for NOS1 (rs2293054) that had the highest intake of these foods had a 50% reduced risk of non-Hodgkin's Lymphoma and up to 30-70% reduced risk of diffuse large B-cell lymphoma.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
| --- | --- | --- | --- | --- |
| SOD2<br>Superoxide dismutase (SOD2) is manganese dependent and protects against superoxide for the mitochondria of the cell. Variants here increase the need for intracellular antioxidant protection. | SOD2-rs4880 | | AG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CAT C-262T<br>CAT makes an enzyme called catalase, which helps reduce oxidative stress. | CAT C-262T-rs1001179 | CC | | |
| GSTM1<br>GSTM1 catalyzes the detoxification of alkyl and polycyclic aromatic hydrocarbons (PAHs), intermediate forms of many carcinogens, specifically metabolically generated epoxide intermediates of benzo(a)pyrene. | GSTM1-rs366631 | | AG | |
| GSTP1 I105V<br>Glutathione S-Transferase (GSTP1) is linked to the metabolism of mutagens, carcinogens, and other poisonous chemicals. It plays a crucial role in the detoxification process, thereby protecting cells from these compounds. GSTP1 rs1695 is connected to breast, prostate, urinary, esophagus, and skin health. | GSTP1 I105V-rs1695 | | AG | |
| GSTP1 C341T<br>Glutathione S-Transferase (GSTP1) is linked to the metabolism of mutagens, carcinogens, and other poisonous chemicals. It plays a crucial role in the detoxification process, thereby protecting cells from these compounds. GSTP1 rs1138272 is connected to the colon, prostate, lung, throat, and fertility. | GSTP1 C341T-rs1138272 | CC | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| GPX1<br>The GPX1 (Glutathione peroxidase 1) gene encodes a protein responsible for the modulation and detoxification of hydroperoxides and hydrogen peroxide to protect the mitochondria and cytoplasm of cells against oxidative damage. | GPX1-rs1050450 | | AG | |
| CTH<br>The CTH (Cystathionine Gamma-Lyase) gene encodes an enzyme in the trans-sulfuration pathway that converts cystathionine derived from methionine into cysteine. Glutathione synthesis in the liver is dependent upon the availability of cysteine. | CTH-rs1021737 | GG | | |
| NOS1<br>NOS1 (nNOS) codes for brain neural transmission, memory, learning, psychological stress, the peripheral nervous system and potentially the lymph nodes. | NOS1-rs545654 | CC | | |
| | NOS1-rs7298903 | TT | | |
| | NOS1-rs3782218 | | | TT |
| NOS2<br>NOS2 (iNOS) encodes for wound, tissue damage, infection and hypoxia (low oxygen). | NOS2-rs2248814 | GG | | |
| ARMS2<br>ARMS2 polymorphism is associated with increased risk of age related macular degeneration (AMD). | ARMS2-rs10490924 | GG | | |

# MENTAL HEALTH & COGNITIVE PERFORMANCE

## MAO-Serotonin

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| MAO-A rs6323 | Heterozygous TG |

### Recap

Improves MAO-A Gene Function: Vitamin B6, folate, B12, B2, magnesium, vitamin C and probiotics.

Decreases Gene Function: Antibiotics, aspartame, oral contraceptives, proton pump inhibitors, high estrogen levels, constipation and deficiencies in the vitamins and minerals above.

MAO-SEROTONIN

**Research**: MAO-A (Monoamine oxidase A) is a critical enzyme involved in breaking down important neurotransmitters such as serotonin, estrogen, norepinephrine, and dopamine. Normal variants for men may not be as relevant as they are for women due to the role of estrogen.

The heterozygous genotype of MAO-A does not have a major impact on MAO-A function, however, MAO-A can still be disturbed by high estrogen levels, constipation, antibiotics, certain medications and vitamin deficiencies.

## Serotonin Receptor-Stress

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| 5-HT2A rs6313 | Homozygous AA |
| 5-HT2A rs6311 | Homozygous TT |

### Recap

Improves Gene Function: Moderate intensity aerobic exercise, cognitive behavioral therapy, mindfulness training, meditation, yoga, tryptophan, green or black tea, prebiotics, probiotics, B2, B6, B12, and folate.

Decreases 5-HT2A Gene Function: Chronic stress, poor gut flora, high-dose lithium, cannabis abuse, and excessive smartphone use.

SEROTONIN RECEPTOR-STRESS

**Research**: The serotonin 2A receptor (5-HT2A) has been implicated in mental disorders with complex etiologies that are still not clearly understood, in processes such as learning and memory, and also in neurogenesis. Although the functional significance of 5-HT2A polymorphisms are not entirely understood, there is evidence that rs6311 modulates transcription factor binding and promoter methylation, affecting gene transcription (the first step of gene expression).

The T allele of the 5-HT2A gene rs6311 has been shown to increase the 5-HT2A expression in vitro and is associated with anxiety, IBS and depressive disorders. It has also been hypothesized that 5-HT2A variants may influence resting vagal activity

among persons with chronically high levels of perceived stress.

In one study in a Han Chinese population, the TT homozygous genotype for rs6311 experienced diminished resting vagal tone compared to the CC genotype when experiencing chronically elevated levels of perceived stress. Low vagal tone is correlated with a lower capacity to regulate stress and has been associated with heightened emotional reactivity and poor inhibitory control in numerous studies in children and adolescents. A meta-analysis also reported a low resting vagal tone in adults with major depression.

One meta-analysis showed that the T allele of rs6311 or the linked A allele of rs6313 was significantly associated with obsessive compulsive disorder (OCD). This result was confirmed in the author's subsequent comprehensive meta-analysis in 2016 with a larger dataset. Multiple studies in this analysis indicated that the rs6311 T allele was more abundant in females with OCD compared to control females.

Another meta-analysis of 37 twin samples suggests that obsessions and compulsions arise from a combination of genetic factors and non-shared environment. OCD might be shaped by a large number of genes of modest impact, which combine to influence the risk for developing OCD. Polymorphisms in genes related to BDNF, GABA, glutamate, serotonin, acetylcholine, glycine, ubiquitin, bradykinin, myelinization, TNFA, gender and environmental trauma may all have a cumulative effect on whether or not someone develops OCD.

Psoriasis is a chronic inflammatory skin disease affecting about 2-4% of the population worldwide, and is thought to be a multifactorial disease with both genetic and immunogenic backgrounds. Psoriasis occurs in connection with stress and mood disorders and is apparently induced in patients who have been treated with antidepressants. The serotonergic system, which consists of serotonin-producing cells, serotonin receptors and serotonin transporters, may play a significant role in psoriasis.

Theanine, a component of green tea and black tea, has been shown to increase BDNF levels, modulate serotonin and dopamine levels, and improve learning and memory. It has shown promise as an adjunct therapy for schizophrenia and depression, and researchers believe there may also be an application for anxiety disorders, panic disorder, OCD, and bipolar disorder.

Vagus nerve stimulation may be a promising add-on treatment for anxiety, depression, PTSD, seizures, and inflammatory bowel disease. Natural ways to stimulate the vagus nerve and increase vagal tone include singing, deep breathing, meditation and yoga. Another way is to make a dietary shift towards good gut bacteria, shown to influence the activity of the vagus nerve.

In human volunteers as well as in a rat model, administration of a probiotic formulation consisting of Lactobacillus helveticus R0052 (traditionally used in the manufacture of Swiss-type cheeses and long-ripened Italian cheeses such as Emmental, Gruyere, Grana Padano and Parmigiano Reggiano) and Bifidobacterium longum R0175A (colonizes at birth, but levels vary genetically) significantly attenuated psychological distress and reduced anxiety-like behavior. Research has also found that prebiotics can improve non-REM sleep as well as REM sleep after a stressful event.

One pilot study found that a 12-week moderate intensity aerobic exercise program reduced OCD symptoms and the reductions lasted 6 months later.

Another study combined cognitive behavioral therapy and a 12-week moderate intensity aerobic exercise program with tremendous results, exceeding effects typically observed with individual and group-based cognitive behavioral therapy for OCD based on leading meta-analytic reviews.

## Dopamine, Adrenaline and Estrogen-COMT

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| COMT V158M rs4680 | Wild Type GG |
| COMT rs4633 | Wild Type CC |

Recap

Improves COMT Gene Function: Vitamin C, magnesium, and copper (copper should not be too low or too high).

Decreases Gene Function: Chronic stress, sugar, proton pump inhibitors, aspartame, low magnesium levels, low vitamin C levels, low and high copper levels, constipation, xenoestrogens, high homocysteine levels, high SAH levels, estrogen-based medications and mercury toxicity.

DOPAMINE, ADRENALINE AND ESTROGEN-COMT

**Research**: COMT (catecholamine methyltransferase) shares a pathway with MAO-A and is the gene for dopamine, estrogen, adrenaline and catecholamine metabolism. This pathway requires magnesium, vitamin C and copper as co-factors.

While the homozygous genotype for COMT V158M is associated with slower enzymatic function and naturally higher dopamine and adrenaline levels, the wild-type COMT V158M gene (GG rs4633) is associated with faster enzymatic function, leading to lower prefrontal dopamine, adrenaline and norepinephrine levels.

The benefits to the GG genotype may be a better response to high-pressure situations and the ability to be more emotionally resilient and calm in a crisis. Those with the GG genotype may even thrive more in response to certain stressors and have enhanced cognitive performance due to the elevation of dopamine and adrenaline to more normal levels.

The downside of the GG genotype is that it can affect executive function and problem-solving abilities compared to the AC and AA genotypes of COMT V158M if dopamine remains low. Individuals who had the GG genotype of COMT and variants in ANKK1 showed the lowest cognitive performance, however, both genes can be improved by increasing catecholamine intake, meditation, balanced blood sugar, vitamin D, omega-3 fatty acids, fiber, high intensity exercise and lower media exposure.

Several studies have found that the COMT V158M GG individuals perform better than those with the AA allele on tasks demanding cognitive flexibility, while individuals with the AA allele are better at tasks demanding focused attention. The “inverted U” hypothesis suggests that when dopamine levels are either too high or too low, cognition is adversely affected.

In a study of Swedish men and women with depression, the GG genotype also appears deleterious with a three-fold increased risk of later cardiovascular disease compared to those non-depressed carrying the GG genotype. The risk was higher in women than in men. A 2016 meta-analysis found that for each cup of coffee, depression was reduced by 8%, being most significant when the caffeine consumption was above 68 mg/day and below 509 mg/day. Due to coffee and caffeine's effect on COMT and dopamine, this genotype with depression may benefit from increased coffee intake. The CYP1A2 gene for caffeine metabolism should also be reviewed.

Small studies have shown that Caucasian carriers of at least one G allele showed a greater effect for social facilitation and cooperativeness (working together in a group) than the AA homozygous group for COMT V158M. In women, the GG genotype was considered to be more helpful and empathetic, socially tolerant, compassionate, and potentially more altruistic.

The GG genotype has also been found to have a higher threshold of pain. In a 2019 study, twenty minutes following exposure to cold stress, subjects with the GG genotype showed a lower biochemical stress response relative to the homozygous AA carriers.

While studies have had mixed results with ADHD and COMT genotypes, research has shown that amphetamines (Adderall) enhanced prefrontal cortex function and improved working memory efficiency for the GG (high COMT activity) subjects, while amphetamine produced adverse effects under high working memory load conditions for homozygous AA (low activity) subjects. A subtype of ADHD is characterized by low dopamine levels.

There are dietary strategies that naturally slow down the COMT enzyme. Catecholamines (coffee, black tea, green tea, red wine, chocolate, citrus, bananas, berries, and vanilla) all help slow down COMT, increasing dopamine and adrenaline. For breast cancer prevention, green tea has been found to be beneficial in the AG and AA genotype, but not the GG genotype. This is due to the AG and AA genotype retaining polyphenols the longest. Therefore, the GG genotype may need a higher intake of green tea to achieve the same benefit.

Coffee can increase dopamine concentration, signaling, and receptor availability, proving very beneficial for those in a lower dopamine state. Research has also found that coffee drinkers have up to a 60% lower risk of Parkinson’s disease likely due to increased dopamine signaling in the brain from caffeine.

Those with lower dopamine and adrenaline levels are also going to do better with exercise that involves an element of risk like surfing, snowboarding, mountain biking, skiing, and athletic competitions to modulate healthy dopamine and adrenaline concentrations. This requirement may be more relevant in men due to higher estrogen levels in women slowing down COMT.

## Dopamine Receptors-ANKK1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ANKK1 rs1800497 | Heterozygous AG |

### Recap

Improves ANKK1 Gene Function: Meditation, 8 hours of sleep per night, balanced blood sugar, vitamin D, omega-3 fatty acids, fiber, high intensity exercise and lower media exposure.

Decreases ANKK1 Gene Function: Low blood sugar, refined sugar, high fructose corn syrup, elevated lead levels, elevated copper levels, iron deficiency, omega-3 deficiency, low vitamin D levels and excessive media exposure.

DOPAMINE RECEPTORS-ANKK1

**Research**: Dopamine is a neurotransmitter with numerous roles, including reward-motivated behavior and social behavior.

Dopamine is involved in trial-and-error learning. Variants in genes related to dopamine signaling may also affect a person's ability to learn.

The heterozygous AG and homozygous AA genotypes have been correlated with up to a 30% reduction in dopamine receptors in a region of the brain known as the striatum. One small study found that people with the wild-type GG genotype learned from their mistakes easily, while people with the AG or AA genotypes were more likely not to learn from their mistakes and repeat behavior with negative consequences.

Those with sugar addictions, compulsive eating and obesity may have systems that need much more stimulation to feel pleasure caused by fewer D2 dopamine receptors and the need for extra stimulation to make the receptors "turn on." Functional MRI studies of teenagers, both lean and obese, found that the teenagers whose brains didn't light up as much in the dopamine reward centers were more likely to be obese and gain weight later. They also were more likely to have fewer dopamine receptors.

Poor dopamine uptake may contribute to the development of obesity. This relationship was significantly stronger in women with a heterozygous or homozygous A1 variant in rs1800497. The "A" corresponds to the A1 allele and the "G" is called the A2 allele. A1 heterozygous or homozygous women had lower dopamine activation in response to food, and therefore gained more weight potentially due to their diminished pleasure response from dopamine.

Fourteen studies investigated mindfulness meditation as the primary intervention and assessed binge eating, emotional eating, and/or weight change. Results suggest that mindfulness meditation effectively decreases binge eating and emotional eating in populations engaging in this behavior. However, evidence for its effect on weight is mixed.

Researchers found that individuals with Internet addiction showed reduced levels of dopamine D2 receptor availability in subdivisions of the striatum. This helps explain the universal iPhone phenomenon of addictive-reward behavior, with excessive use decreasing dopamine receptors and increasing the craving for more.

The global statistics show that about 10 percent of the world's population has ADHD. When researchers looked specifically at teenagers in the US, they found the diagnoses had risen 52 percent since 2003. ADHD has been associated with decreased dopamine activity. A meta-analysis of 11 studies with 1645 cases and 1641 controls found that variants in rs1800497 may be associated with ADHD.

Studies have also found that children and adults with ADHD are significantly more likely to be overweight, showing the shared connection to decreased dopamine levels. The heavy metal lead disrupts the dopamine pathway, and 16 out of 18 studies found a significant association between blood lead levels and one of the types of ADHD (Combined / Inattentive / Hyperactive-Impulsive). Other research has shown that iron deficiency causes a reduced number of dopamine receptors, and a recent study from the Annals of Medical and Health Sciences Research found that low serum iron, ferritin levels, and vitamin D deficiency may be associated with ADHD.

 Vitamin C is proposed as a neuromodulator of glutamate, dopamine, acetylcholine and GABA transmission and related

behaviors. One study showed that following a long period of vitamin C deficiency, depressed levels of both dopamine and norepinephrine were reported. Vitamin C also reduces blood lead levels.

Mindfulness training may improve self-regulation of attention. Neuroimaging studies suggest that mindfulness meditation engenders neuroplastic changes in brain areas associated with attentional functioning typically impaired in ADHD. One study found meditation increased endogenous dopamine release of 65% in the ventral striatum during meditation.

## Histamines and Migraines-HNMT

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| HNMT C314T rs11558538 | Heterozygous TC |

### Recap

Improves HNMT Gene Function: Vitamin C, choline, folate, magnesium, chamomile, basil, stinging nettle, echinacea, fennel, ginger and wild oregano.

Decreases HNMT Gene Function: Poor gut flora, too many fermented foods, red wine, NSAID's, antidepressants, histamine H2 blockers, antihistamines, antiarrhythmics, immune modulators, deficiencies in vitamin C, choline, folate and magnesium.

HISTAMINES AND MIGRAINES-HNMT

If you have also the GG genotype for DAO rs1049793, the co-presence of the T allele (TC or TT) in HNMT rs11558538 may increase the degree of disability of migraines from histamines. Further studies are needed to confirm the HNMT polymorphism connection to migraines.

## Anandamide-FAAH

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| FAAH rs324420 | Wild Type CC |

### Recap

Improves FAAH Gene Function: Exercise over 30 minutes, red clover tea (women), kaempferol, cacao, genistein (fermented soy), Echinacea, 7-hydroxyflavone (parsley, onions, berries, tea, and citrus fruits), β-caryophyllene (cloves, rosemary, hops).

Decreases FAAH Gene Function: Pesticides and phthalates.

ANANDAMIDE-FAAH

Anandamide is a neurotransmitter and endogenous cannabinoid, and is known as the “bliss” molecule that targets the endocannabinoid system.

The endocannabinoid system is involved in many physiological processes including reward, addiction, fertility, pain and energy regulation. This system was named from the cannabis plant, such as marijuana and hemp. THC closely resembles anandamide.

The endocannabinoids play a significant role in pain modulation and inflammation, and have been demonstrated to relieve pain by activating the CB1 and CB2 receptors.



The wild-type genotype (CC) encodes for the fast activity of FAAH, and therefore naturally leads to lower anandamide levels. Those with the homozygous genotype (AA), have the slow-activity of FAAH and naturally higher levels of anandamide. This

means that the CC individuals may have more anxiety and have to work harder to achieve higher levels of happiness, while the AA individuals have less anxiety and naturally higher levels of the "bliss" molecule that stimulate feelings of happiness.

Low levels of anandamide have been linked to slower extinction of fear memories and a heightened stress response to threatening situations than those with higher anandamide levels. Healthy volunteers who carried the rs324420 "A" allele (low FAAH activity, high anandamide levels) had much less amygdala activation when placed in a threatening situation. They also had a weaker correlation between amygdala activation and trait anxiety, which is a general tendency to perceive situations to be threatening and to respond to such situations with subjective feelings of apprehension and tension.

Pesticides such as chlorpyrifos and diazinon alter the endocannabinod system and researchers have hypothesized that eating organic foods lacking pesticide residues may promote endocannabinoid balance. Phthalates are plasticizers added to water bottles, tin cans, food packaging, and even the enteric coating of pharmaceutical pills. Phthalates may act as endocrine disruptors and carcinogens, and have been found to block CB1 receptors, found in the brain.

However, there are also ways for people to lower excessive levels of chronic stress and anxiety by increasing anandamide levels in the body. One of best ways to do this is with exercise. Endorphins (endogenous opioids) enhance the effects of cannabinoids and what has been known as the "runner's high" may in fact be the increase of anandamide. Research found that running and biking over 30 minutes, along with strenuous hiking at high altitude significantly increased anandamide.

Clinical anecdotes suggest that stress-reduction techniques, such as meditation, yoga, and deep breathing exercises impart mild cannabimimetic effects.

## Panic and PTSD-GAD1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| GAD1 rs3749034 | Heterozygous AG |

### Recap

Probiotics, B6, B2, taurine, magnesium, lithium, choline, vitamin C, zinc, vitamin D, progesterone (women), CBD, lemon balm, ashwagandha, high intensity exercise for 8-20 minutes, endurance exercise, yoga, meditation, and deep sleep.

Antibiotics, caffeine, high estrogen, excess wheat, excess sugar, broth cooked over 24 hours, low blood sugar, poor sleep, manganese deficiency, boron deficiency, chronic stress, proton pump inhibitors, diuretics, hormone replacement therapy, MAOI's, fibrates, MSG, low progesterone, sucralose and aspartame.

PANIC AND PTSD-GAD1

GAD1 stands for "Glutamate Decarboxylase 1" and is responsible for the conversion of glutamate to GABA. GABA and glutamate account for 80% of brain activity. Glutamate is excitatory while GABA is calming. In the right amounts, glutamate helps focus, cognitive function and productivity. Too much, however, can be excitatory and detrimental.

The GAD system influences mood stability and the pathophysiology of mood and anxiety disorders. To date, GAD1 genetic variants have been associated with mood disturbance, and panic disorder. GAD1 SNPs may impact both mood and anxiety-like traits, and may also be relevant following stress or trauma exposure in influencing risk for PTSD as well as depression.

The subjects carrying A allele of rs3749034 were associated with an increased risk of Posttraumatic stress disorder when compared to subjects with the "G" allele in the dominant model.

GABA levels in various brain regions are reduced in panic patients possibly due to impaired GAD function. Further studies in patients with major depression found reduced GABA levels to be accompanied by increased glutamate concentrations strengthening the link between anxiety and mood disorders and GAD.

Following a trauma, individuals at higher genetic risk with certain genotypes in GAD1 may experience physiological effects of anxiety, overconsolidation of the fear memory, and negative thoughts about the event, decreasing their ability to extinguish fear responses when reminded of the trauma and increasing the likelihood of mood-related disturbances. Therefore the correlation with a genetic predisposition to a higher trauma response may require variants in GAD1, an environmental trauma,

and gender to due the influence of estrogen on GAD.

Estrogen and progesterone decrease GAD expression in the amygdala and the hippocampus (which both are involved in regulating fear), which provides a link between hormone levels and anxiety as well as mood changes during menstruation in women. Natural progesterone in women (B6 helps produce progesterone) has powerful effects on enhancing GABA activity in the brain. When progesterone is too low, it causes elevated glutamate levels.

Abnormalities in the GABA neurotransmitter system have been noted in subjects with mood and anxiety disorders, which is why anticonvulsants are also marketed for mood disorders. Lithium and the drug Lamictal has been shown to help regulate the neurotransmitter glutamate by keeping the amount of glutamate between brain cells at a stable, healthy level. The anticonvulsant drug Topamax is used for migraines by lowering glutamate and raising GABA levels.

Excess glutamate is supposed to convert to GABA with B6 and magnesium. GAD1 variants slow down the conversion of glutamate to GABA and increase the need for B6/magnesium to make it run normally. Studies have found that exercise helps the brain direct excess glutamate to be used as an energy source and prevent toxic build-up.

GABA requires adequate probiotics (bifidobacterium produces large amounts of GABA, so the FUT2 gene function should also be assessed) zinc, B2, B6, vitamin C, vitamin D and deep sleep to keep glutamate in check. Taurine (found in grass-fed animal protein, wild fish and eggs) appears to increase the levels of GAD1 to reduce glutamate and help bind to GABA receptors in brain cells.

One study found that neuronal excitability from glutamate appears to be attenuated when eating or supplementing with the mushroom Lion's Mane. Research on Lion's Mane also shows that the hot water extract stimulates Nerve Growth Factor (part of a family of similar proteins that serve to promote the health and normal function of the brain and nervous system) and accelerates the growth of the myelin sheath. This has exciting potential for those with neurodegenerative disorders from high glutamate levels.

The artificial sweetener aspartame is especially troubling for those with GABA and glutamate imbalances. The lowered levels of serotonin due to aspartame consumption might cause lowered activity of the GABA transporters.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MAO-A<br>MAO-A (Monoamine oxidase A) is a critical enzyme involved in breaking down important neurotransmitters such as serotonin, estrogen, norepinephrine, and dopamine. | MAO-A-rs6323 | | TG | |
| 5-HT2A<br>The 5-HT2A gene encodes for serotonin receptors found in the brain and central nervous system and is concentrated in the brain region essential for learning and cognition. Polymorphisms in rs6314 may result in reduced episodic memory in young and middle-aged individuals. | 5-HT2A-rs6314 | GG | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| 5-HT2A<br>The 5-HT2A gene encodes for serotonin receptors found in the central nervous system. Polymorphisms in rs6311 and rs6313 may contribute to a reduced capacity to regulate stress, low vagal tone, anxiety, depression, OCD, and IBS, especially in females. | 5-HT2A-rs6313 | | | AA |
| | 5-HT2A-rs6311 | | | TT |
| COMT V158M<br>COMT is connected to dopamine, adrenaline, estrogen and catecholamine metabolism. | COMT V158M-rs4680 | GG | | |
| | COMT-rs4633 | CC | | |
| ANKK1<br>ANKK1 modulates the density of dopamine receptors in the brain. | ANKK1-rs1800497 | | AG | |
| DAO C2029G<br>DAO participates in the degradation of extracellular histamine. This gene is connected to migraines. | DAO C2029G-rs1049793 | CC | | |
| HNMT C314T<br>Histamine N-methyltransferase (HNMT) is a histamine-metabolising enzyme expressed in the brain. This gene is connected to migraines. | HNMT C314T-rs11558538 | | TC | |
| HNMT<br>Histamine N-methyltransferase (HNMT) is a histamine-metabolising enzyme expressed in the brain. This gene is connected to hyperactivity and food dyes. | HNMT-rs1050891 | | AG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| FAAH<br>FAAH (fatty acid amide hydrolase) is a gene that encodes for anandamide breakdown, a neurotransmitter and endogenous cannabinoid. | FAAH-rs324420 | CC | | |
| PEMT<br>Choline is required for acetylcholine, a neurotransmitter of the vagus nerve that enervates numerous organs. | PEMT-rs12325817 | CC | | |
| | PEMT-rs7946 | CC | | |
| GAD1<br>GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA. | GAD1-rs3749034 | | AG | |
| BDNF<br>BDNF is a synaptic modulator of glutamate while GABA synapses are also regulated by BDNF. | BDNF-rs6265 | CC | | |
| APOE<br>Apolipoprotein E (APOE) is a lipid binding protein that transports triglycerides and cholesterol in multiple tissues, including the brain. | APOE-rs7412 | | TC | |
| | APOE-rs429358 | TT | | |
| GAD1<br>GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA. | GAD1-rs769407 | GG | | |
| | GAD1-rs3791851 | TT | | |
| | GAD1-rs3791850 | | AG | |
| | GAD1-rs2241165 | | TC | |

# DETOXIFICATION

## Liver Enzyme-CYP1B1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP1B1*6 L432V rs1056836 | Wild Type GG |

### Recap

Improves CYP1B1 Gene Function: Iodine, apigenin, quercetin, myricetin, chrysoeriol (rooibos tea and celery) ghee, vitamin C and resveratrol.

Decreases Gene Function: Heterocyclic amines, xenoestrogens, high biotin supplementation, oral contraceptives, hormone replacement therapy, excessive sun exposure, vegetable oils, grains, fried meat, excess of smoked foods, cigarette smoke exposure and exhaust.

LIVER ENZYME-CYP1B1

**Research**: Due to the carcinogenic activation of polycyclic aromatic hydrocarbons (cigarette smoke, burning coal, vegetable oils, grains) and estrogens to genotoxic catechol estrogens - both which cause DNA mutations - variants in the CYP1B1 gene are important for breast, ovarian, colon, lung and prostate health. This is especially true for those with variants in GSTM1 and GSTP1. CYP1B1 may also be important for skin health, with excessive sun exposure negatively affecting CYP1B1 expression.

CYP1B1 participates in the first step of estrogen metabolism, the conversion of estrogens to 2- or 4-hydroxyestrogens, and specifically catalyzes the 4-hydroxylation of estrogens. 4-hydroxyestradiol is inactivated by COMT.

According to NCBI, C encodes the Leucine and G the Valine. The CYP1B1 L432V rs1056836 GG (valine) is associated with increased CYP1B1 messenger ribonucleic acid (mRNA) expression with a subsequent elevation in 4-hydroxyestradiol formation resulting in increased estrogen-mediated carcinogenicity. However, this has not been proven in human studies.

Minimizing polycyclic aromatic hydrocarbons, xenoestrogens and high estrogen levels in the body are a priority for CYP1B1. Vegetable oils (soy, corn) have been found to be one of the highest sources of polycyclic aromatic hydrocarbons, while also being a high source of omega-6 fatty acids that can disturb the healthy omega-3 and omega-6 ratio needed to prevent skin cancer growth.

A meta-analysis of 12 studies found that coffee consumption decreased the risk of cutaneous melanoma, while another study found that 2 cups of dark roast coffee per day for one month caused a 23% reduction in DNA damage.

Research has shown that optimal levels of iodine can help modulate the estrogen pathway and help prevent cancerous growth by targeting CYP1A1 and CYP1B1. Iodine deficient breast tissue exhibits early markers of breast cancer, and 30% of iodine stores are in the breast tissue.

One study found that high-dose biotin supplementation (often used in isolation for hair growth) increased CYP1B1 expression and was associated with an increase in the occurrence of single-stranded DNA breaks compared with biotin-deficient cells; while inhibitors of CYP1B1 prevented DNA strand breaks.

Inhibition of CYP1B1 activity was observed for the flavonols quercetin, apigenin and myricetin, while resveratrol has shown to convert to piceatannol through CYP1B!, a tyrosine kinase inhibitor and a compound of known anticancer activity. Chrysoeriol, present in rooibos tea and celery, also acts selectively to inhibit CYP1B1 in vitro and may be especially relevant to patients with CYP1B1 overactivity.

One study in 259 post-menopausal women found that for those with certain genotypes in CYP1B1 (rs1056836), KRAS (rs61764370) and MTHFR (rs1801133 and rs1801131), oral contraceptives and hormone replacement therapy was associated with shorter leukocyte telomere length. Shorter leukocyte telomeres are connected to premature aging, and may increase the

risk of cancer, cardiovascular disease, obesity, diabetes, chronic pain, and sensitivity to perceived psychological stress.

In observational studies, higher levels of exercise are related to longer telomere lengths in various populations, and athletes tend to have longer telomere lengths than non-athletes. This relationship is particularly evident in older individuals and physical activity may confer protection against stress-related telomere length shortening.

Higher coffee consumption has been associated with longer telomeres among female nurses. Be aware that there is a compounding effect with caffeine on the slow metabolizer CYP1A2 CC genotype. Research has shown that oral contraceptives significantly prolong the half-life of caffeine from 6.2 hours to 10.7 hours, and therefore could theoretically cause more cardiovascular issues from caffeine for the CYP1A2 CC genotype.

## Liver Enzyme-CYP2D6

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP2D6 T100C rs1065852 | Homozygous AA |

### Recap

Improves CYP2D6 Gene Function: Unknown.

Decreases CYP2D6 Gene Function: Bupropion, fluoxetine, paroxetine, quinidine, and terbinafine.

LIVER ENZYME-CYP2D6

**Research**: Research has found that CYP2D6*10 (rs1065852) variants result in decreased enzymatic activity. The polymorphism of CYP2D6 significantly affects the pharmacokinetics of about 50% of the drugs in clinical use, which are CYP2D6 substrates. Approximately 7% of the population has reduced activity of the CYP2D6 isoenzyme of cytochrome P450. These individuals are "poor metabolizers." Please discuss further with your doctor and look into further testing for a full CYP2D6 pharmacogenomic panel.

## Aromatic Amines-NAT2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| NAT2 rs1495741 | Homozygous AA |

### Recap

Improves NAT2 Gene Function: Cruciferous vegetables, unfiltered fermented drinks, meat and fish marinades, blueberries, blackberries, red grapes, kiwi, watermelon, rosemary, parsley, carotenoids, and vitamin C.

Decreases NAT2 Gene Function: Smoking, commercial hair dyes, industrial and manufacturing plants, charred meat, and diesel exhaust.

AROMATIC AMINES-NAT2

**Research**: N-acetyltransferase 2 (NAT2) could influence the detoxification of numerous drugs, and chemical carcinogens including aromatic amines. Aromatic amines are chemicals found in industrial and manufacturing plants, tobacco smoke, commercial hair dyes, and diesel exhaust.



Generally, the NAT2 phenotype can be classified into slow, intermediate, and rapid acetylator. The AA genotype is the slow

acetylator, and numerous studies have associated the NAT2 slow acetylator phenotype with bladder cancer risk in smokers found in America, Europe, and Asia. However, in nonsmokers, rs1495741 AA did not increase susceptibility to bladder cancer when compared to GG and AG genotypes.

Exposure to aromatic amines has been found to increase the risk of breast cancer in those that work in rubber factories, use hair dyes that contain 4-aminobiphenyl (which also affects Tp53), and consistently consumed meat cooked at high temperatures. Research has shown the aromatic amine formed with meat cooked at high temperatures may cause both DNA damage and cause the proliferation of estrogen-sensitive cancer cells.

Heterocyclic aromatic amines, known mutagens formed in cooked meat and fish at high temperatures, are considered the causative agents for the association between meat intake and prostate cancer risk. Researchers found that a high heterocyclic aromatic amine intake was significantly associated with an increased risk of prostate cancer among Japanese men with the NAT2 slow acetylator phenotype, CYP1A1 rs1048943 TC and CC genotype, and CYP1A2 AC and AA genotype.

Marinades, cruciferous vegetables, unfiltered fermented drinks, blueberries, blackberries, red grapes, kiwi, watermelon, rosemary, and parsley all help reduce the carcinogenic risk posed by heterocyclic amines in meat cooked at high temperatures.

## Statins-COQ2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| COQ2 rs4693596 | Homozygous CC |

### Recap

Improves COQ2 Gene Function: CoQ10.

Decreases COQ2 Gene Function: Statin drugs.

STATINS-COQ2

**Research**: Statin drugs deplete CoQ10 and therefore may affect people more with variants in this pathway. One study found that people with the homozygous CC genotype were the most at risk for statin induced myopathy (muscle cramps, stiffness, and spasm). However, a study done in the Czech population in 2017 did not find an association with polymorphisms in COQ2 and low-dose statin drug therapy.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CYP1A1*2C 4889<br>CYP1A1 is in the estrogen metabolism pathway along with CYP1B1, CYP1A2, CYP31A, SULT's and COMT. CYP1A1 is involved in the metabolism of benzopyrene. | CYP1A1*2C 4889-rs1048943 | TT | | |
| CYP1A2 C164A<br>CYP1A2 metabolizes various environmental procarcinogens, such as heterocyclic amines, nitrosamines, aflatoxin B1 and ochratoxin A. | CYP1A2 C164A-rs762551 | | AC | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CYP1B1*6 L432V<br>The CYP1B1 gene metabolizes pro-carcinogens such as polycyclic aromatic hydrocarbons and 17 beta-estradiol. | CYP1B1*6 L432V-rs1056836 | GG | | |
| CYP2C9*3 A1075C<br>Variants in CYP2C9 rs1057910 may alter the metabolism of THC, the psychoactive compound found in cannabis. | CYP2C9*3 A1075C-rs1057910 | AA | | |
| CYP2D6 T100C<br>CYP2D6 metabolizes approximately 50% of drugs in clinical use. | CYP2D6 T100C-rs1065852 | | | AA |
| CYP3A4*1B<br>The CYP3A4 enzyme is involved in the metabolism of approximately 50% of drugs that are used today, cholesterol homeostasis, and the oxidative deactivation of testosterone. | CYP3A4*1B-rs2740574 | TT | | |
| CYP2C19*17<br>Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens. | CYP2C19*17-rs12248560 | CC | | |
| NAT2<br>The NAT2 gene encodes an enzyme that functions to activate and deactivate arylamine, hydrazine drugs, and carcinogens. | NAT2-rs1495741 | | | AA |
| COQ2<br>The COQ2 gene encodes an enzyme that functions in the final steps in the biosynthesis of CoQ10 and homozygous variants may increase the risk of statin induced myopathy. | COQ2-rs4693596 | | | CC |

# CARDIOVASCULAR HEALTH AND ATHLETIC PERFORMANCE

## Power and Recovery-ACTN3

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ACTN3 rs1815739 | Wild Type CC |

Recap

Improves ACTN3 Gene Function: Not applicable for ACTN3.

Decreases ACTN3 Gene Function: Not applicable for ACTN3.

POWER AND RECOVERY-ACTN3

ACTN3 is currently the most promising gene for predicting the likelihood of becoming an Olympic level sprint and power athlete in males and females. The RR (CC) genotype expresses the ACTN3 protein found in Type II muscle fibers, which produces explosive and powerful contractions.

A 2019 meta-analysis of 44 studies and 20,753 individuals, found that the RR genotype is associated with enhanced strength and training adaptation, improved protection from eccentric training-induced muscle damage, and lower risk of sports injury, and reduced frailty in the elderly. Other research has shown that testosterone levels were higher in male and female athletes with at least one R allele compared to the XX genotypes.

Studies in both Ironman athletes and ultra runners found that the RR genotype experienced the least amount of muscle damage during and after the competition, reducing the risk of rhabdomyolysis and other health complications during ultra-endurance competitions. However, there was no difference in race time or perceived exertion between all three genotypes.

For resistance training, two studies reported that the RR genotype was associated with the most significant increase in strength and power following resistance training in men and women. Women with the RR genotype (compared to XX genotype carriers) had lower muscle leg power initially but had higher increases after strength training.

Numerous studies have shown that the RR genotype significantly reduced the risk of ankle injuries and that XX genotypes were 2.6 times more likely to suffer injuries than RR genotypes. These injuries were also more likely to be of increased severity.

A higher frequency of the ACTN3 RR genotype has been found in Olympic level sprint and power athletes (sprinters, jumpers, and throwers) in Australians, Finnish, Greek, Russian, African, Israeli and Japanese athletes. Researchers have found it is rare for humans with the XX genotype to qualify for the 200-meter and 400-meter competitions at the Olympic Games.

There was some evidence for a dose-effect of the ACTN3 R allele and 200-meter sprint speed in elite male African athletes. The ACTN3 RR individuals had (on average) a faster best personal sprint time than ACTN3 RX individuals.

The XX genotype for ACTN3 has a higher baseline VO2 max than the RR genotype. However, RR genotypes are hyper-responders to exercise, and the difference was eliminated with consistent endurance training according to a study on police recruits.

## VO2 Max-PPARGC1A

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| PPARGC1A rs8192678 | Homozygous TT |

## Recap

Improves PPARGC1A Gene Function: Aerobic exercise, cold water exposure, ashwagandha and eleuthero root.

Decreases PPARGC1A Gene Function: Sedentary lifestyle.

VO2 MAX-PPARGC1A

**Research**: Peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PPARGC1A) is a master regulator of mitochondrial biogenesis, mitochondrial respiration, skeletal muscle fiber transformation (from fast to slow twitch), glucose and fatty acid metabolism, and the anti-oxidation machinery. PPARGC1A is expressed in cell types with high oxidative function (heart, skeletal muscle slow twitch fibers, liver, and pancreas) and in brown adipose tissue.

Several studies have shown that SNPs in PPARGC1A are associated with a significant lower level in aerobic power (i.e., VO2 max) in insulin resistant and untrained individuals as well as in athletes. Healthy untrained adults display a large individual variation in VO2 max that ranges from -20% to more than 50%.

Research indicates that the exercise-induced variation in VO2 max is 47% explained by genetics. If you have heterozygous or homozygous variants in PPARGC1A, you may have a naturally lower VO2 max for aerobic exercise and increased CRP (C-reactive protein) levels.

To increase VO2 max, consider cold exposure. Since mitochondria are what give us the ability to use oxygen in order to produce cellular energy, the more we have the more the aerobic potential.

Cold exposure activates the PPARGC1A gene and PGC1 protein, which makes more mitochondria in the muscle. One study found that 15 minute exposure to cold water (50°F or 10°C) following high intensity running, increases PGC1 in muscle tissue. Another study found that men that were immersed in cold water at 50°F (10°C) for 15 minutes, 3 times a week for four weeks after running were able to increase mitochondrial biogenesis occurring in their muscle tissue.

Adaptogens are another way to increase your VO2 max. One study found that ashwagandha increased velocity, power, VO2 max, lower limb muscular strength and neuromuscular coordination. A second study used elite Indian cyclists for 8 weeks. One group received 500mg of the root extract 2x a day, while the other group received a placebo. There was significant improvement in the experimental group in all parameters, namely, VO2 max and time for exhaustion on treadmill.

A study using eleuthero root found that using 800mg for 8 weeks increased VO2 max of by 12%, endurance time improved 23%, the highest heart rate increased 4%, and metabolism was altered which spared glycogen storage. The study concluded that “this was the first well-conducted study that shows that 8-week ES supplementation enhances endurance capacity, elevates cardiovascular functions and alters the metabolism for sparing glycogen in recreationally trained males.”

## Muscle Recovery-IL6

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| IL6 rs1800795 | Heterozygous CG |

Recap

Improves IL6 Gene Function: Whey protein, cold water immersion, American ginseng, curcumin, allicin, optimal testosterone levels, vitamin C, and collagen protein.

Decreases Gene Function: Low testosterone (men), depression, obesity, bacterial overgrowth and workout routines without enough recovery days.

MUSCLE RECOVERY-IL6

**Research**: Exercise increases IL6 cytokines even when muscle damage hasn't occurred. It is produced in large amounts during heavy weight lifting and endurance races. The CG genotype is more common in sprint and power athletes compared to endurance and non-athletes.

C-allele carriers of the IL6 SNP have been found to have higher creatine kinase values (a marker of muscle damage) following exercise compared with GG homozygotes.

The highest post-exercise creatine kinase levels are found after prolonged exercise such as ultra distance marathon running, weight lifting and downhill running.

To accelerate recovery, whey protein, cold water immersion, American ginseng, curcumin, optimal testosterone levels, vitamin C and collagen protein have all been found to attenuate creatine kinase levels.

Research has also found that purple sweet potatoes, cranberries, blueberries and beet root juice have verified health, performance-enhancing, and exercise recovery benefits.

Perhaps the most promising results have come from two separate studies showing decreased muscle soreness and increased recovery from cherry juice and dehydrated cherry supplements. One of these studies had subjects perform ten sets of ten repetitions at 70% of a 1-RM back squat. The researchers found that Montmorency powdered tart cherry supplementation used daily and 48 hours post-workout significantly lowered muscle soreness strength decrement during recovery, and markers of muscle catabolism throughout the 48 hour post-lifting recovery period compared to placebo.

## Muscle Injury-COL1A1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| COL1A1 rs1800012 | Wild Type CC |

Recap

Improves COL1A1 Gene Function: Vitamin C, zinc, copper, glycine, proline, lysine and B6 (all precursors to collagen production) and cryotherapy.

Decreases COL1A1 Gene Function: Deficiencies in vitamin C, zinc, copper, glycine, proline, lysine, B6 and excessive NSAID use.

MUSCLE INJURY-COL1A1

**Research**: According to one study, the gene encoding for the alpha1 chain of type I collagen (COL1A1) has been shown to be associated with cruciate ligament ruptures and shoulder dislocations.

You have the CC genotype for COL1A1, which lowers the production of Type 1 collagen. Approximately 90% of collagen in the body is Type I. Type I collagen is found in the skin, tendons, corneas, lungs and in 95% of bone.

ACL ruptures are considered the most severe injury sustained in sports. The A variant produces more COL1A1. Two AA's reduced risk of ACL rupture by ten times, while only 5% of the population have two AA's.

Cryotherapy has been shown to inhibit harmful collagenase (activity on collagen enzyme that breaks down collagen) and also decreased the production of inflammatory E2 series prostaglandins. For athletes, cryotherapy post-training could be a useful tool to help prevent injuries.

## Caffeine-CYP1A2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP1A2 C164A rs762551 | Heterozygous AC |

### Recap

Increases CYP1A2 Gene Function: A higher cruciferous vegetable intake may help increase caffeine metabolism for those with the CC slow metabolizer genotype, along with exercise.

Decreases CYP1A2 Gene Function: Oral contraceptives.

CAFFEINE-CYP1A2

You have the heterozygous AC genotype and are considered an “intermediate metabolizer” of caffeine. This means that you do not metabolize caffeine slowly or quickly.

If you are female and taking oral contraceptives, this may reduce the clearance of caffeine. Research has shown that oral contraceptives significantly prolong the half-life of caffeine from 6.2 hours to 10.7 hours.

It is important to review your COMT gene function to better understand a sensitivity to coffee intake.

## Triglycerides-FADS1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| FADS1 rs174546 | Heterozygous TC |

### Recap

Improves FADS1 Gene Function: Higher intake of the omega-3 fatty acids EPA and DHA.

Decreases FADS1 Gene Function: Low intake of EPA and DHA.

TRIGLYCERIDES-FADS1

**Research**: Variants in the FADS1 SNP (rs174546) are associated with elevated triglyceride levels, which appears to be due to a higher need for EPA and DHA from animal foods. Studies have found that plasma triglyceride levels were lower in wild-type CC genotype when compared to carriers of the minor T allele.

Population average triglyceride levels have increased since 1976 in parallel with the constant growing epidemic of obesity, insulin resistance and Type-2 diabetes. A meta-analysis of 17 population-based prospective trials including 46,413 men and 10,864 women identified plasma triglycerides levels as an independent risk factor of cardiovascular disease.

Triglycerides are essentially fat in the blood that are driven by excess sugar and carbohydrate consumption. They are the driving force behind lipoprotein particles that are potent causes of heart disease, such as small LDL and very low-density lipoprotein (VLDL).

Numerous studies have found that omega-3 fatty acids administered as fish oil supplements lowers plasma triglyceride levels by 25% to 34%. While fish oil is known to lower triglycerides, there doesn’t appear to be a difference in the FADS1 genotype response to supplementation. Looking at your NO3 gene function would be helpful in determining your fish oil response with

elevated triglycerides.

A meta-analysis of 13 randomized controlled trials found that 500mg of vitamin C resulted in a significant decrease in serum LDL cholesterol and triglyceride concentrations.

## Potassium and Magnesium-ADD1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ADD1 rs4961 | Heterozygous TG |

### Recap

Improves ADD1 Gene Function: Lower sodium intake, magnesium, potassium, calcium, garlic, vitamin D and omega-3's.

Decreases Gene Function: High sodium intake, excess weight, high sugar intake, sedentary lifestyle, smoking and stress.

POTASSIUM AND MAGNESIUM-ADD1

**Research**: A meta-analysis of 33 studies with 40,432 participants found that variants in rs4961 was significantly associated with hypertension in Asians. Other research found that carriers of the risk (T) allele responded better to diuretics and sodium-restricted diets, in that they tended to lower their blood pressure by ˜10 mmHg points compared to rs4961(GG) homozygotes similarly treated.

Excess weight, high sugar intake, sedentary lifestyle, smoking, stress and high sodium intake all raise blood pressure. People living at higher latitudes throughout the world are at higher risk of hypertension, and patients with cardiovascular disease are often found to be deficient in vitamin D. Magnesium, potassium, calcium, vitamin D, garlic and omega-3's all lower blood pressure.

One study found that increasing potassium-rich foods to 4.7 grams was equivalent to cutting out 4 grams of sodium in terms of reducing blood pressure.

In another study, aged garlic extract given at a dose of 600-1500mg was just as effective as the drug atenolol in reducing blood pressure over a 24-week period.

## Phytoestrogens-TMPRSS2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| TMPRSS2 rs2070788 | Wild Type GG |

### Recap

Improves Gene Function: Phytoestrogens, curcumin, and lycopene from tomato sauce.

Decreases Gene Function: Smoking and low phytoestrogen intake.

PHYTOESTROGENS-TMPRSS2

Both angiotensin I converting enzyme 2 (ACE2) and the transmembrane protease, serine 2 (TMPRSS2), are crucial for SARS-CoV-2 entry into host cells. While ACE2 is the main receptor for the spike protein (coronaviruses are known for their crown of

spikes) of both SARS-CoV and SARS-CoV-2, mediating viral attachment to target cells, TMPRSS2 cleaves the spike protein. TMPRSS2 allows the fusion of viral and cellular membranes. This process is similar to viral activation and cell entry of other coronaviruses, including SARS-CoV and influenza viruses such as influenza H1N1.

TMPRSS2 expression is several times higher in the prostate compared with any other tissue, as well as the upper digestive and respiratory tract. ESR2 is also found in the prostate, lungs, breast, and the cardiovascular system with implications in blood clotting. TMPRSS2 acts like the shape of the keyhole, while ACE2 is the actual lock. A higher expression of TMPRSS2 means a better keyhole fit for viruses. Smoking is one way that promotes a higher expression of TMPRSS2 and increases the risk of SARS-CoV-2 infection.

In a study looking at the Italian population, expression levels of both ACE2 and TMPRSS2 were assessed. Researchers found no significant evidence that ACE2 is associated with COVID-19 severity or sex bias in the Italian population. However, TMPRSS2 levels and genetic variants proved to be possible candidate disease modulators, contributing to the observed epidemiological data among Italian patients. Genes related to higher levels of TMPRSS2 were more frequent in Italians vs. East Asian populations.

The genetic predisposition to severe pH1N1 2009 influenza virus was evaluated in Chinese human subjects, finding that the GG genotype of rs2070788 led to an increased expression of TMPRSS2, a risk variant for a severe pH1N1 influenza infection and it was significantly associated with the susceptibility to IAV H7N9 (Avian flu).

Research has found that the expression of the fusion gene TMPRSS2:ERG is thought to be responsible for up to 80% of prostate cancers, and is repressed by estrogen receptor beta (ESR2 gene) agonists. Phytoestrogens are agonists known to have up to 30-fold higher affinity for estrogen receptor beta.

Japan has exceptionally low levels of prostate cancer, and the risk rises when their traditional diet changes to a Westernized diet. The Japanese also have some of the lowest death rates from COVID-19 despite having a large elderly population. The traditional Japanese diet contains high levels of dietary phytoestrogens. Since phytoestrogens upregulate estrogen receptor beta and lower the expression of TMPRSS2, and therefore alter the keyhole for SARS-CoV-2 to enter, we may be seeing a nutrigenomic strategy in place that is slowing the virus at the door.

To decrease TMPRSS2 expression, increase your intake of phytoestrogens, curcumin, and lycopene (tomato sauce). Research has shown that curcumin binds to receptor-binding domain site of viral S protein and also to the viral attachment sites of ACE2 receptor and downregulates TMPRSS2, demonstrating that curcumin can act as potential inhibitory agent antagonizing the entry of SARS-CoV2 viral protein.

Variants in the ESR2 gene also increase the need for phytoestrogens for prostate and breast health. Post-menopausal women will also benefit from increasing phytoestrogen intake.

The best phytoestrogens in research for blood pressure and the ESR2 gene include dark berries (contains resveratrol), beans, rye, hummus, peanuts (contains resveratrol), miso soup, flax seeds (women), tahini sauce, and cruciferous vegetables (broccoli, cabbage, kale, Brussels sprouts).

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| ACTN3<br>ACTN3 encodes for the alpha-actin-3 protein found exclusively within type-II fast-twitch muscle fibers. | ACTN3-rs1815739 | CC | | |
| PPARGC1A<br>It has been demonstrated that variants in the PPARGC1A gene affect the exercise-induced change in maximal oxygen uptake (VO2). | PPARGC1A-rs8192678 | | | TT |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| TNFA<br>Tumor necrosis factor (TNF-a) is a pro-inflammatory cytokine. Variants may increase the risk of asthma in Asian populations. | TNFA-rs1800629 | GG | | |
| IL6<br>IL6 is an interleukin that acts as both a pro-inflammatory cytokine and an anti-inflammatory myokine. | IL6-rs1800795 | | CG | |
| SOD2<br>Superoxide dismutase (SOD2) is manganese dependent and protects against superoxide for the mitochondria of the cell. The homozygous genotype increases the need for antioxidant support in high-intensity athletes. | SOD2-rs4880 | | AG | |
| COL1A1<br>COL1A1 produces alpha 1 chain of type I collagen, a major protein in tendons and ligaments. | COL1A1-rs1800012 | CC | | |
| PON1<br>PON1 (Paraoxonase) plays a large role in removing pesticides. It is also involved with supporting HDL function and LDL oxidation. | PON1-rs662 | TT | | |
| LPA<br>Lp(a)is a sticky form of LDL that appears to affect plaque growth, LDL particle size and increase the risk of plaque rupture and blood clotting. | LPA-rs3798220 | TT | | |
| CYP1A2 C164A<br>Variants in CYP1A2 determine caffeine metabolism and effects on bone density and cardiovascular health. | CYP1A2 C164A-rs762551 | | AC | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| 9p21<br>9p21 is considered an important genetic marker for cardiovascular health. | 9p21-rs4977574 | | | GG |
| FADS1<br>FADS1 is involved in fatty acid metabolism, and variants in this gene are associated with elevated triglyceride levels. | FADS1-rs174546 | | TC | |
| ESR2<br>ESR2 codes for estrogen receptor beta (ER-), one of two main types of estrogen receptor activated by estrogen and is linked to fibrinogen levels in post-menopausal women. | ESR2-rs4986938 | | TC | |
| F5<br>Variants in F5 increase the risk of deep vein thrombosis, especially if using oral contraceptives. | F5-rs6025 | CC | | |
| ADRB2<br>Beta-2 adrenergic receptor (ADRB2) is abundantly expressed in cardiac cells, and bronchial smooth muscle cells and is connected to stress levels and heart health. | ADRB2-rs1042713 | GG | | |
| ACE1 G2350A<br>ACE1 is part of the renin-angiotensin system responsible for the conversion of angiotensin I to angiotensin II, constricting blood vessels and elevating blood pressure. | ACE1 G2350A-rs4343 | | AG | |
| ADD1<br>Variants in ADD1 are associated with hypertension in Asians. | ADD1-rs4961 | | TG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| AGTR1<br>Angiotensin-II receptor type 1 (AGTR1) is a major component of the renin-angiotensin system for regulating blood pressure and is highly expressed in adipose tissue, liver, leukocytes and the intestine. The homozygous genotype may increase the risk of high blood pressure from excess dietary fat and carbohydrate intake. | AGTR1-rs5186 | | AC | |
| ACE2 A8790G<br>ACE2 is part of the renin-angiotensin system, responsible for degrading angiotensin II and providing balance to ACE1 by dilating blood vessels and lowering blood pressure. | ACE2 A8790G-rs2106809 | | AG | |
| TMPRSS2<br>Transmembrane Serine Protease 2 is highly expressed in the prostate and lungs, and the expression is associated with viral susceptibility and prostate cancer. | TMPRSS2-rs2070788 | GG | | |

# DNA PROTECTION, DAMAGE & REPAIR

## DNA Repair-ATM

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ATM D1853N rs1801516 | Heterozygous AG |

### Recap

Improves ATM Gene Function: Folate, higher nut, vegetable and fruit intake, exercise, and intermittent fasting (waiting 13-16 hours to eat from dinner to breakfast).

Decreases ATM Gene Function: Smoking, obesity (especially abdominal fat), diabetes, binge drinking, chronic pancreatitis, heterocyclic amines, polycyclic aromatic hydrocarbons and isolated fructose.

DNA REPAIR-ATM

**Research**: People who have a variants in the ATM gene will benefit from nutrients that have been found in studies to improve DNA repair in regards to pancreatic health. While early studies linked ATM gene variants to breast health, further research has shown conflicting results, with ATM variants being potentially only being relevant when coupled with other genes like BRCA-1 and BRCA-2 and familial breast cancer.

DNA repair is needed when cells are harmed by sunburns, chemicals, toxins and stress. Efficient repair of damaged DNA strands helps maintain the stability of the cell's genetic DNA. DNA repair enzymes are typically working poorly in families with a lot of cancer and require more support. Nutrition plays a major role in DNA repair enzymes.

**Pancreatic Health**

The risk for pancreatic cancer goes up with diabetes. One study found that compared to non-diabetics with the ATM D1853N normal GG genotype, diabetics carrying the ATM D1853N GA/AA genotypes had more than triple the risk of developing pancreatic cancer. This makes stabilizing blood sugar a priority.

Studies have found that a high dietary intake of fresh fruit and vegetables reduced the risk of developing pancreatic cancer, and recent epidemiological studies have associated nut consumption with a protective effect against it.

One cohort study found a significantly decreased risk of pancreatic cancer by 55% for the highest levels of dietary folate compared with the lowest. Another cohort found that the highest blood folate levels showed a significantly decreased risk compared to the lowest. Folic acid supplements did not show a protective effect in these studies.

Review your genes for blood sugar, insulin, and folate.

**Breast and Ovarian Health**

If breast cancer runs in your family and you have done BRCA testing, the following research will be helpful in your nutrition plan. BRCA-1 and BRCA-2 are tumor suppressor genes that are responsible for DNA repair and linked to breast and ovarian health. It is the reduced function with certain variants that causes impaired DNA repair. BRCA1-associated tumors commonly display a triple-negative (TN) phenotype lacking expression of estrogen receptor (ER), progesterone receptor (PR) and the human epidermal growth factor receptor 2 (HER2).

Research has found that women with the BRCA-1 and BRCA-2 mutations who consumed up to 27 different fruits and vegetables a week (variety important) saw their cancer risk diminish by fully 73 percent. Selenium and choline have both been found to improve BRCA-1 and BRCA-2 function and lower the risk of breast cancer. Iodine also plays a special role in breast health. Check your PEMT gene function to see your need for choline.

The compound luteolin found in celery, broccoli, thyme and parsley was found in animal studies to kill cancer cells, stop triple-negative cells spreading to the lungs and block spreading throughout the body. Another study found that blueberry extract decreased proliferation of triple-negative breast cancer cell lines.

Lignans are highest in flax seeds and research shows that women who have the highest level of lignans in their body have the lowest risk of breast cancer. In postmenopausal women, lignans can cause the body to produce less active forms of estrogen.

Animal studies have shown that both flaxseed oil and lignans can reduce breast tumor growth and spread, even for ER negative cancer cells. One study in mice concluded that flaxseed inhibited the growth of human estrogen-dependent breast cancer.

Another study found that enoki mushroom extract was shown to inhibit the growth of both estrogen-receptor positive (ER+) MCF-7 and estrogen-receptor negative human breast cancer cell lines. Furthermore, the extract inhibited breast cancer cell colony formation by 99%.

## Prostate-ESR2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ESR2 rs2987983 | Homozygous GG |

### Recap

Improves ERS2 Gene Function: Phytoestrogen foods, milk thistle, apigenin, and iodine.

Decreases ERS2 Gene Function: Obesity, BPA plastic, unfiltered tap water, atrazine (sprayed on golf courses, lawns, non-organic corn and non-organic wheat), dioxins (bleached products, non-organic animal fats) and phthalates (many chemically-based personal care products).

PROSTATE-ESR2

The ER-beta estrogen receptor has features of a tumor suppressor gene and is strongly expressed in the breast, bone, cardiovascular system, uterus, bladder, prostate, lung, ovarian cells, and testicular cells.

ERS2 is highly expressed in the prostate, and the expression declines when the prostate becomes enlarged and with cancerous prostate cells. Dietary phytoestrogens are a consistent source of debate for health benefits and concerns in the scientific community for men and women. Phytoestrogens can bind to estrogen receptors and exert both estrogenic and anti-estrogenic effects depending on the tissue, and the signaling pathways differ from estrogen.

In a case-control study in Sweden from 2006, the overall decreased risk of prostate cancer of carriers of the variant allele of ESR2 (rs2987983) was almost 60% with a high phytoestrogen dietary intake (but not lignans) compared to men with a low phytoestrogen intake, whereas no such association was found among men with the wild-type genotype.

Phytoestrogens can both bind to estrogen receptors and stimulate sex hormone-binding globulin (SHBG) production, changing the amount of 17β-estradiol or testosterone in circulation. Phytoestrogens are also able to inhibit proteasome, which appears essential for breast cancer cell survival. Apigenin - a flavonoid found in celery and parsley - has been found to be capable of inhibiting proteasomes, leading to the stabilization of ERS2 and apoptosis of prostate cancer cells.

The main sources of phytoestrogens in the study were flaxseed, rye bread, wheat bread, cereals, berries, soy, and other beans. Researchers concluded that phytoestrogens and the ERS2 gene interact synergistically in a fraction of the population with the heterozygous or homozygous genotype (rs2987983) by repressing androgen receptors, inhibiting androgen-driven proliferation.

Iodine modulates the estrogen pathway and research has shown that there is a low incidence of cancers of the prostate, endometrium, ovary, and breast in populations consuming diets with a high iodine content. Additionally, a German study performed on men with prostate cancer found a significant inverse relationship between vitamin K2 consumption and advanced prostate cancer.

A combined analysis of CYP1A1, CYP1A2, CYP3A4, CYP1B1, SHBG, and COMT could give more insight into individual estrogen metabolism.

## Breast-ESR2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| ESR2 rs2987983 | Homozygous GG |

### Recap

Improves ERS2 Gene Function: Phytoestrogen foods (especially flax seeds), milk thistle, fermented soy (Asians), and iodine.

Decreases ERS2 Gene Function: Obesity, BPA plastic, unfiltered tap water, atrazine (sprayed on golf courses, lawns, non-organic corn, and non-organic wheat), dioxins (bleached products, non-organic animal fats), and phthalates (many chemically-based personal care products).

BREAST-ESR2

**Research**: Genes involved in estrogen biosynthesis, metabolism, and signal transduction have been suggested to affect breast cancer susceptibility. It is important to note that there is a cumulative value of SNPs that increase or decrease cancer risk according to the research. Therefore, these genes should be analyzed in the context of all related genes.

A total of 318 sporadic breast cancer cases and 318 age-matched controls were included in the study. With regard to homozygous genotypes, women with sporadic breast cancer more frequently carried the GG genotype of ESR2 promoter SNP rs2987983. The A allele was found to be more frequent in healthy women. A systematic analysis found that rs2987983 was also significantly associated with breast cancer risk as well as a study with North Indian women.

A review of several epidemiological studies suggests that high dietary intake of phytoestrogens from fermented soy, in the amount typically consumed by Asian populations, may have protective effects against breast cancer. According to in-Rong Zhou, Ph.D., assistant professor of surgery at Harvard Medical School, “the combination of soy and tea (especially green tea) significantly prevented the growth of estrogen-dependent breast cancer in a synergistic manner in our research.”

However, a meta-analysis indicated that risk reduction from soy was limited to Asian populations, and therefore there may be genetic differences that determine the response between Asian and Western populations with soy.

Iodine intake from seaweed consumption may also play a role in breast health as seen in Asian populations. Research has observed that Japanese women who consume a high iodine content diet have a low incidence of benign and malignant breast disease, but this protective advantage is lost once they immigrate to other countries.

It is estimated that 30 percent of iodine stores are in the breast tissue, and it has been shown to exert as powerful of an antioxidant effect as vitamin C. Iodine deficient breast tissue exhibits the early markers of cancer development and research has shown that there is a low incidence of cancers of the prostate, endometrium, ovary, and breast in populations consuming diets with a high iodine content.

A combined analysis of CYP1A1, CYP1A2, CYP3A4, CYP1B1, SHBG, and COMT could give more insight into individual estrogen metabolism.

## Longevity-SIRT1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| SIRT1 rs7895833 | Wild Type AA |

## Recap

Improves SIRT1 Gene Function: Exercise, fasting, 7-8 hours of sleep per night, sauna, polyphenols, vitamin D, omega-3 fatty acids, resveratrol, magnesium, and melatonin.

Decreases SIRT1 Gene Function: The APOE-e4 genotype, high blood sugar, and insulin resistance.

LONGEVITY-SIRT1

**Research**: SIRT1 regulates numerous genes that accelerate the aging process, modulate DNA repair mechanisms and transcription factors like p53 (tumor suppressor gene), FOXOs (key regulators of lipid metabolism, stress resistance, and apoptosis) and inhibits NF-kb, a pathway connected to viral inflammation.

SIRT1 activity goes down as we age, and DNA damage accumulates, and its activity is especially harmed by a sedentary lifestyle, poor diet, and obesity. Activation of sirtuins induces the growth of blood vessels, insulin sensitivity and better glucose control, and other health benefits in a wide range of age-related cardiovascular and metabolic disease models. Experimental models have shown that increasing the activity of the sirtuins is associated with the delay of age-related diseases and potentially increasing longevity.

Researchers have observed a significant increase in SIRT1 levels in longevity populations and found a significant positive correlation between SIRT1 levels and age in a Turkish population. The oldest people carrying AG genotypes for rs7895833 had the highest SIRT1 level compared to the AA genotype, suggesting an association between rs7895833 SNP and lifespan longevity.

The average age of older people carrying AG genotype (76.0 ± 1.5 years) was significantly higher than the average age of older people carrying AA genotype (71.3 ± 1.4 years).

Your APOE genotype may also affect SIRT1 activity for longevity. Research from the Buck Institute group found that APOE-e4 reduced expression of SIRT1. The reduced expression of SIRT1 was thought to impair beta-amyloid clearance observed in Alzheimer's. If you have the APOE-e4 allele, the AA SIRT1 genotype may require more SIRT1 activation.

Polyphenols are activators of SIRT1 and contain anti-inflammatory and apoptosis properties. These include piceatannol (a metabolite of resveratrol), olive oil, fisetin (strawberries, apples, grapes), quercetin (wine, peppers, berries, apples) and resveratrol (wine, blackberries, blueberries, pistachios and dark chocolate).

Other activators of SIRT1 that also benefit the APOE-e4 carriers include magnesium, melatonin, vitamin D, and omega-3 fatty acids. One study found that centenarians (those living over 100) have higher total body magnesium and lower calcium levels than most elderly people.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
| --- | --- | --- | --- | --- |
| ATM D1853N<br>ATM coordinates DNA repair by activating enzymes that fix double stranded DNA breaks. | ATM D1853N-rs1801516 | | AG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| ESR2<br>ESR2 acts as a tumor suppressor gene that codes for estrogen receptor beta (ER-beta), one of two main types of estrogen receptor activated by estrogen. ESR2 is strongly expressed in the prostate. | ESR2-rs2987983 | | | GG |
| ESR2<br>ESR2 acts as a tumor suppressor gene that codes for estrogen receptor beta (ER-beta), one of two main types of estrogen receptor activated by estrogen. ESR2 is strongly expressed in the breast. | ESR2-rs2987983 | | | GG |
| TP53<br>TP53 is a tumor suppressor gene responsible for DNA repair. | TP53-rs1042522 | | | CC |
| MDM2<br>Variants in the MDM2 gene encode a protein that reduces cellular levels of the p53 tumor suppressor protein. | MDM2-rs2279744 | TT | | |
| MLH1<br>MLH1 codes for a DNA repair enzyme linked to colon health. | MLH1-rs1800734 | GG | | |
| GATA3<br>GATA3 factors are involved in cellular maturation with proliferation arrest and cell survival. | GATA3-rs4143094 | GG | | |
| SIRT1<br>SIRT1 senses changes in intracellular NAD+ levels and plays a role in DNA damage and repair. | SIRT1-rs7895833 | AA | | |

# METHYLATION CYCLE

## Folate-MTHFR 677

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| MTHFR 677 rs1801133 | Heterozygous AG |

Recap

Improves MTHFR 677 Gene Function: Riboflavin and methylfolate.

Decreases MTHFR 677 Gene Function: Proton pump inhibitors, oral contraceptives, NSAIDs, anticonvulsants, antivirals, antibiotics, acid blockers/antacids and hypothyroidism.

FOLATE-MTHFR 677

The frequency of the 677 polymorphism of MTHFR in the Caucasian population is up to 50% heterozygous.

The heterozygous MTHFR 677 has a 30% reduced function, potentially creating a higher need for dietary methylfolate depending on climate, skin tone and sun exposure, and dietary B2, choline, betaine, B6 and B12 intake. Variants in MTHFR 677, especially the homozygous genotype, are higher in Mediterranean climates and malaria-endemic regions like Southeast Asia. Researchers believe these variants were selected to protect against UV-induced DNA damage and malaria.

While a heterozygous MTHFR 677 and MTHR 1298 have been associated with higher homocysteine levels, not all people will develop high homocysteine levels.

Homocysteine is a non-protein amino acid that is created and recycled in the methylation cycle. Sluggish enzymes in the cycle can cause elevated levels in the blood, which can cause inflammation in the blood vessels. High homocysteine has been implicated in amyloid buildup, DNA damage and cancer, mitochondrial dysfunction, cardiovascular disease, age related macular degeneration, apoptosis of neurons and depression. BH4 structurally resembles folate and has been described to be reduced in endothelial cells when increased levels of homocysteine are present. Stabilizing MTHFR with B2 and targeting

One study in 259 post-menopausal women found that for those with variants in CYP1B1 (rs1056836), KRAS (rs61764370) and MTHFR (rs1801133 and rs1801131), oral contraceptives and hormone replacement therapy was associated with shorter leukocyte telomere length. Shorter leukocyte telomeres are connected to premature aging, and may increase the risk of cancer, cardiovascular disease, obesity, diabetes, chronic pain, and sensitivity to perceived psychological stress.

A large meta-analysis showed the lack of statistically significant association between MTHFR mutations and coronary heart disease except in the Middle East and Japan, where it portrayed statistical significance.

It is important to consider riboflavin intake, PEMT, MTR/MTRR, and CBS activity to assess overall homocysteine metabolism. Too high or too low levels of B12, B6, folate or their co-factors may cause dysregulation of methyl donor activity.

## Folate-MTHFR 1298

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| MTHFR 1298 rs1801131 | Heterozygous TG |

Recap

Improves MTHFR 1298 Gene Function: Vitamin C, L-arginine, folate, B6, magnesium, holy basil, selenium, royal jelly and deep breathing techniques.

Decreases MTHFR 1298 Gene Function: Chronic stress, oral contraceptives, high levels of mercury, arsenic, lead and aluminum, synthetic folic acid, phenylalanine, aspartame, oxidative stress and high protein diets.

FOLATE-MTHFR 1298

The heterozygous MTHFR 1298 has a reduced function of approximately 20%. If you have the heterozygous MTHFR 1298 and a heterozygous MTHFR 677, you may have elevated homocysteine levels and may require a higher folate intake (400-800 mcg).

One study in 259 post-menopausal women found that for those with variants in CYP1B1 (rs1056836), KRAS (rs61764370) and MTHFR (rs1801133 and rs1801131), oral contraceptives and hormone replacement therapy was associated with shorter leukocyte telomere length. Shorter leukocyte telomeres are connected to premature aging, and may increase the risk of cancer, cardiovascular disease, obesity, diabetes, chronic pain, and sensitivity to perceived psychological stress.

On its own, the heterozygous MTHFR 1298 genotype may not pose any issues with adequate folate intake, however vitamin C, L-arginine, folate, B6, magnesium, holy basil, selenium, royal jelly and deep breathing techniques will help healthy MTHFR 1298 gene function.

## B6-CBS

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CBS A13637G rs2851391 | Homozygous TT |

Recap

Improves CBS Gene Function: B6 and SAMe as co-factors, selenium and folate to increase arsenic detoxification.

Decreases Gene Function: Antibiotics, arsenic, birth control, ACE inhibitors, antacids, proton pump inhibitors, Phenytoin, bronchodilators, Digoxin, diuretics, hormone replacement therapy, Estradiol, MAO inhibitors, St. John's Wort, high cysteine and Parnate.

B6-CBS

**Research**: CBS is an important enzyme in the transsulfuration pathway that catalyzes the conversion of homocysteine (HCY) to cystathionine, a substrate for glutathione synthesis.

The CBS gene requires B6 and healthy SAMe production to regulate function. Deficiencies in CBS activity are the most frequent cause of familial high homocysteine and the underlying cause of the CBS genetic disorder homocystinuria, which is characterized by severe high homocysteine levels.

Research has hypothesized that rs2851391 variants might reduce the activity of CBS, and thus was positively associated with homocysteine levels and a marginal association with decreased plasma B12 levels.

One study demonstrated a significant association of both elevated homocysteine levels and low vitamin B6 levels with CBS polymorphisms in the presence of nonvalvular atrial fibrillation.

Hydrogen sulfide (H2S) may also need to be the focus with CBS and homocysteine levels. H2S is produced in the brain, pancreas, liver, reproductive tissues. Low levels of HS2 affect repair of the GI tract and disrupted levels of HS2 can lead to cognitive deficits or excitation in the brain.

Reduced CBS activity could cause low H2S concentrations, affecting mitochondrial health and the gut/brain axis. Abnormalities of hydrogen sulfide in the body have been identified in several disorders including ulcerative colitis, Alzheimer’s disease, Down’s syndrome, and possibly in diabetes.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MTHFR 677<br>The MTHFR 677 gene encodes the MTHFR gene to convert folate into the active form, methylfolate. Variants in this gene slow down enzymatic function. | MTHFR 677-rs1801133 | | AG | |
| MTHFR 1298<br>MTHFR 1298 is involved in converting 5-methylfolate (5MTHF) to tetrahydrofolate (THF). Unlike MTHFR 677, the 1298 variant does not lead to elevated homocysteine levels unless paired with a heterozygous MTHFR 677. | MTHFR 1298-rs1801131 | | TG | |
| MTHFD1 G1958A<br>(Methylenetetrahydrofolate dehydrogenase 1) encodes a protein that possesses three distinct enzymatic activities in the interconversion of 1-carbon derivatives of tetrahydrofolate. | MTHFD1 G1958A-rs2236225 | GG | | |
| DHFR A20965G<br>Dihydrofolate reductase (DHFR) catalyzes the reduction of dihydrofolate to tetrahydrofolate (THF) and affect synthetic folic acid metabolism. | DHFR A20965G-rs1643659 | TT | | |
| | DHFR C19483A-rs1677693 | GG | | |
| MTR A2756G<br>MTR (methionine synthase) combines folate, methyl B12 and homocysteine into methionine. | MTR A2756G-rs1805087 | AA | | |
| MTRR A66G<br>MTRR attaches a methyl group to B12 and variants here will slow the process. When both MTR and MTRR exist, dysfunction can occur. | MTRR A66G-rs1801394 | | AG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MAT1<br>MAT1 helps produce sufficient SAMe. Variants may decrease SAMe production and increase the need for magnesium to produce SAMe. Use extreme caution with SAMe supplementation. | MAT1-rs2993763 | GG | | |
| PEMT<br>Variants in PEMT may increase the need for choline and increase the sensitivity to anticholinergic drugs. | PEMT-rs12325817 | CC | | |
| | PEMT-rs7946 | CC | | |
| CBS A13637G<br>The Cystathione Beta-Synthase (CBS) enzyme pulls homocysteine to hydrogen sulfide (H2S) and glutathione, requiring B6 and SAMe as a modulator. | CBS A13637G-rs2851391 | | | TT |
| CBS 191150T<br>The Cystathione Beta-Synthase (CBS) enzyme pulls homocysteine to hydrogen sulfide (H2S) and glutathione, requiring B6 and SAMe as a modulator. CBS rs234709 and rs4920037 assists in arsenic detoxification. | CBS 191150T-rs4920037 | GG | | |

| Gene | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| 5-HT2A | 5-HT2A-rs6314 | GG | | |
| | 5-HT2A-rs6313 | | | AA |
| | 5-HT2A-rs6311 | | | TT |
| 9p21 | 9p21-rs4977574 | | | GG |
| ABCG2 (Q141K) | ABCG2 (Q141K)-rs2231142 | GG | | |
| ACAT1-02 | ACAT1-02-rs3741049 | GG | | |
| ACE1 G2350A | ACE1 G2350A-rs4343 | | AG | |
| ACE2 A8790G | ACE2 A8790G-rs2106809 | | AG | |
| ACSL1 | ACSL1-rs9997745 | GG | | |
| ACTN3 | ACTN3-rs1815739 | CC | | |
| ADD1 | ADD1-rs4961 | | TG | |
| ADIPOQ | ADIPOQ-rs2241766 | | TG | |
| ADRB2 | ADRB2-rs1042713 | GG | | |
| AGTR1 | AGTR1-rs5186 | | AC | |
| ALDH2 | ALDH2-rs671 | GG | | |
| ANKK1 | ANKK1-rs1800497 | | AG | |
| APB1 | APB1-rs10156191 | | TC | |
| APOA2 | APOA2-rs5082 | | AG | |
| APOE<br>You have the ApoE e2/e3 genotype, improving cholesterol transport and the maintenance of brain neurons. The ApoE e2 allele is more protective against cognitive decline, heart disease, and is associated with a greater probability for longevity. | APOE-rs7412 | | TC | |
| | APOE-rs429358 | TT | | |
| ARMS2 | ARMS2-rs10490924 | GG | | |
| ATM D1853N | ATM D1853N-rs1801516 | | AG | |
| BCMO1 A379V | BCMO1 A379V-rs7501331 | CC | | |
| BCMO1 R267S | BCMO1 R267S-rs12934922 | | AT | |
| BDNF | BDNF-rs6265 | CC | | |
| CAT C-262T | CAT C-262T-rs1001179 | CC | | |
| CBS 191150T | CBS 191150T-rs4920037 | GG | | |

| Gene | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CBS A13637G | CBS A13637G-rs2851391 | | | TT |
| COL1A1 | COL1A1-rs1800012 | CC | | |
| COMT | COMT-rs4680 | GG | | |
| | COMT-rs4633 | CC | | |
| COQ2 | COQ2-rs4693596 | | | CC |
| CTH | CTH-rs1021737 | GG | | |
| CYP1A1 | CYP1A1-rs1048943 | TT | | |
| CYP1A2 | CYP1A2-rs762551 | | AC | |
| CYP1B1*6 L432V | CYP1B1*6 L432V-rs1056836 | GG | | |
| CYP2C19*17 | CYP2C19*17-rs12248560 | CC | | |
| CYP2C9*3 A1075C | CYP2C9*3 A1075C-rs1057910 | AA | | |
| CYP2D6 T100C | CYP2D6 T100C-rs1065852 | | | AA |
| CYP2R1 | CYP2R1-rs10741657 | | AG | |
| CYP3A4*1B | CYP3A4*1B-rs2740574 | TT | | |
| DAO C2029G | DAO C2029G-rs1049793 | CC | | |
| DHFR A20965G | DHFR A20965G-rs1643659 | TT | | |
| DHFR C19483A | DHFR C19483A-rs1677693 | GG | | |
| DI01 | DI01-rs2235544 | | AC | |
| DI02 | DI02-rs225014 | TT | | |
| ESR2 | ESR2-rs4986938 | | TC | |
| | ESR2-rs2987983 | | | GG |
| F5 | F5-rs6025 | CC | | |
| FAAH | FAAH-rs324420 | CC | | |
| FADS1 | FADS1-rs174546 | | TC | |
| FADS2 | FADS2-rs1535 | | AG | |
| | FADS2-rs174575 | | CG | |
| FTO | FTO-rs9939609 | | AT | |
| | FTO-rs17817449 | | TG | |

| Gene | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| FUT2 | FUT2-rs601338 | GG | | |
| | FUT2-rs1047781 | AA | | |
| GAD1 | GAD1-rs3749034 | | AG | |
| | GAD1-rs769407 | GG | | |
| | GAD1-rs3791851 | TT | | |
| | GAD1-rs3791850 | | AG | |
| | GAD1-rs2241165 | | TC | |
| GATA3 | GATA3-rs4143094 | GG | | |
| GPX1 | GPX1-rs1050450 | | AG | |
| GSTM1 | GSTM1-rs366631 | | AG | |
| GSTP1 C341T | GSTP1 C341T-rs1138272 | CC | | |
| GSTP1 I105V | GSTP1 I105V-rs1695 | | AG | |
| HFE-C282Y | HFE-C282Y-rs1800562 | GG | | |
| HNMT | HNMT-rs1050891 | | AG | |
| HNMT C314T | HNMT C314T-rs11558538 | | TC | |
| IL6 | IL6-rs1800795 | | CG | |
| LCT | LCT-rs4988235 | | | AA |
| LPA | LPA-rs3798220 | TT | | |
| MAO-A | MAO-A-rs6323 | | TG | |
| MAT1 | MAT1-rs2993763 | GG | | |
| MDM2 | MDM2-rs2279744 | TT | | |
| MLH1 | MLH1-rs1800734 | GG | | |
| MTHFD1 G1958A | MTHFD1 G1958A-rs2236225 | GG | | |
| MTHFR 1298 | MTHFR 1298-rs1801131 | | TG | |
| MTHFR 677 | MTHFR 677-rs1801133 | | AG | |
| MTR A2756G | MTR A2756G-rs1805087 | AA | | |
| MTRR A66G | MTRR A66G-rs1801394 | | AG | |
| NAT2 | NAT2-rs1495741 | | | AA |
| NBPF3 | NBPF3-rs4654748 | | TC | |

| Gene | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| NOS1 | NOS1-rs545654 | CC | | |
| | NOS1-rs7298903 | TT | | |
| | NOS1-rs3782218 | | | TT |
| NOS2 | NOS2-rs2248814 | GG | | |
| PEMT | PEMT-rs12325817 | CC | | |
| | PEMT-rs7946 | CC | | |
| PON1 | PON1-rs662 | TT | | |
| PPAR-alpha | PPAR-alpha-rs1800206 | CC | | |
| PPARGC1A | PPARGC1A-rs8192678 | | | TT |
| SHBG | SHBG-rs12150660 | | TG | |
| | SHBG-rs1799941 | | AG | |
| | SHBG-rs6258 | CC | | |
| SIRT1 | SIRT1-rs7895833 | AA | | |
| SLC22A5 | SLC22A5-rs1045020 | CC | | |
| | SLC22A5-rs17622208 | | AG | |
| | SLC22A5-rs2073643 | | TC | |
| | SLC22A5-rs274549 | | | CC |
| | SLC22A5-rs274550 | | | TT |
| | SLC22A5-rs274551 | | | CC |
| | SLC22A5-rs274570 | CC | | |
| | SLC22A5-rs274558 | AA | | |
| | SLC22A5-rs274557 | TT | | |
| | SLC22A5-rs17689550 | CC | | |
| | SLC22A5-rs274567 | CC | | |
| | SLC22A5-rs671473 | CC | | |
| | SLC22A5-rs2631359 | CC | | |
| | SLC22A5-rs4646301 | GG | | |
| | SLC22A5-rs274571 | AA | | |
| | SLC22A5-rs635619 | GG | | |
| | SLC22A5-rs2073642 | CC | | |
| SLC23A1 | SLC23A1-rs33972313 | CC | | |
| SOD2 | SOD2-rs4880 | | AG | |
| TCF7L2 | TCF7L2-rs7903146 | CC | | |

| Gene | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| TMPRSS2 | TMPRSS2-rs2070788 | GG | | |
| TNFA | TNFA-rs1800629 | GG | | |
| TP53 | TP53-rs1042522 | | | CC |