Comprehensive Health Report

Welcome to the future of health and human potential

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NUTRIENT METABOLISM & DIGESTION

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 e4 allele is common in hunter-gatherer communities, while the e3 and e2 alleles are most common in agricultural 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 | NORMAL

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

AVERAGE | INCREASED | HIGH

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.

- Due to improved conversion of ALA to EPA, you can include more plant-based ALA to reach your daily omega-3 target
- 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

Fat Requirements

Monounsaturated and Polyunsaturated

AVERAGE | INCREASED | HIGH

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 genotypes are associated with an average requirement for monounsaturated and polyunsaturated fats from olive oil, avocados, poultry, nuts and seeds

Fat Requirements

Saturated Fat (Red Meat)

VERY LOW | LOW | NORMAL

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

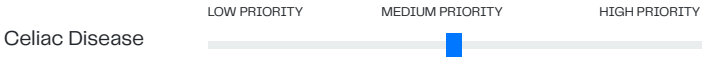
Saturated Fat (Dairy)

VERY LOW | LOW | NORMAL

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 improved metabolism of saturated fat from dairy

Celiac Disease



Celiac disease is an immune reaction to eating gluten, a protein found in wheat, barley and rye. Published research shows that approximately 30 percent of the general population have variants in the celiac disease risk genes HLA-DQA1 through HLA-DQB, yet only 3% of these individuals develop celiac disease.

- Your genotype combination is associated with a slight risk for celiac disease
- The diagnosis for celiac disease is more than two times higher in females than in males
- On a global level, the rates of celiac disease are not related either to the amount of wheat consumed by each country or to the prevalence of the HLA DR3-DQ2 and DR4-DQ8 genotypes worldwide
- First-degree relatives of people with celiac disease including parents, siblings and children have a 1 in 10 risk compared to 1 in 100 in the general population, which may be increased by existing autoimmune disorders
- Talk with your doctor about further testing if celiac disease is suspected

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 an average need for B2

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 a higher than average need for B6
- 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
- B6 is high in yellowfin tuna (6 oz., 1.8mg), wild salmon (6 oz,. 1.2mg), liver (3oz., 0.8mg), chicken breast (6 oz., 1mg), unfiltered fermented drinks (16oz., 0.8mg), pistachios (1 oz., 0.5mg), avocado (1 whole, 0.5mg), sweet potatoes (1 whole, 0.3mg), and spinach (1/2 cup, 0.1mg)

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 an average need for folate

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 an average need for boron

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

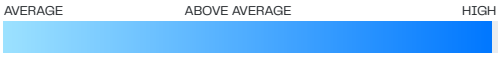
Vitamin A

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 an average need for vitamin E

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 a higher sensitivity to low vitamin K2 intake
- Vitamin K2 is highest in natto (3.5oz., 108mcg MK-7), Münster cheese (1.7 oz., 50mcg of MK-4 and MK-7), Camembert cheese (1.7 oz., 34mcg of MK-4 and MK-7), dark chicken meat (6 oz., 90mcg MK-4), and pork chops (6 oz. 112mcg MK-4)

Micronutrient Requirements

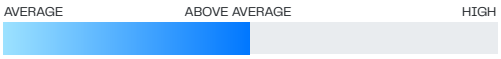
Magnesium

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), and cultivated blueberries (1/2 cup, .33mg)

Micronutrient Requirements

Lithium

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 a higher than average need for lithium if your B12 levels are high
- Lithium levels in food and water range dramatically around the world
- Concentrations reaching approximately 200 mcg/L have been found in drinking water in selected regions of the USA (Texas), Greece, Japan, England, and Italy
- The mean concentration of lithium in European bottled waters, however, was estimated at 0.94 mcg/L
- In Germany, mineral waters were reported to contain 1.5–1,320 mcg/L of lithium

Micronutrient Requirements

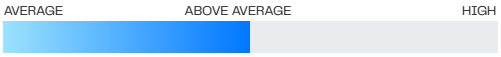
Potassium

The recommended daily allowance (RDA) for potassium is 3,400mg for males and 2,600mg for females. Potassium is an electrolyte that helps maintain normal levels of fluid inside our cells, muscle contraction, and regulates blood pressure. The Paleolithic hunter-gatherers took in about 11,000 milligrams of potassium a day from fruits, vegetables, leaves, flowers, roots, and other plant sources, and under 700 mg of sodium.

- Your genotype is associated with an average requirement for potassium

Micronutrient Requirements

Iron



The Recommended Dietary Allowance (RDA) for all age groups of men and postmenopausal women is 8 mg/day and the RDA for premenopausal women is 18 mg/day.

- Your genotype combinations are associated with with lower serum iron levels and a moderate need for dietary iron intake
- Animal-based foods and seafood contains heme iron, while plant foods contain non-heme iron
- Heme iron has a higher absorption rate compared to non-heme iron
- Iron is highest in oysters (3oz, 8mg), beef liver (3 oz., 5mg) beef 6 oz., 4mg), sardines (3 oz., 2mg) white beans (1 cup, 8mg) dark chocolate (3 oz., 7mg), spinach (1/2 cup cooked, 3mg)

Micronutrient Requirements

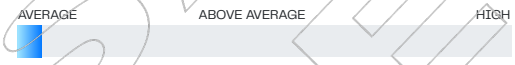
Selenium

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 a higher than average need for selenium
- Selenium is depleted by oral contraceptives, Statin drugs, and hormone replacement therapy
- Selenium is hightest in oysters (3.5 oz., 130mcg), pork chops (6 oz., 80.6 mcg), beef (6 oz., 61.2 mcg), chicken breast (6 oz., 54.2 mcg), shrimp (3 oz., 42.1 mcg), eggs (2 whole, 40mcg), shiitake mushrooms (1 cup, 36 mcg), and sourdough wheat bread (2 slices, 24.1mcg)

Micronutrient Requirements

Zinc

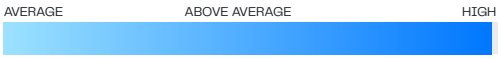


The recommended daily allowance (RDA) for zinc is 11mg. Zinc is poorly absorbed from plant foods and is highest in animal foods. Zinc plays a special role with numerous genes connected to immunity, cancer prevention, detoxification, skin health, eye health and more.

- Your genotype is associated with an average serum zinc levels

Micronutrient Requirements

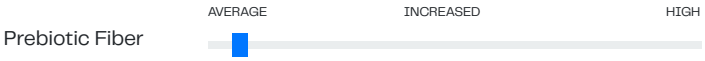
Copper



Typical diets meet or exceed the copper RDA and copper deficiency is rare. The RDA for copper is 900mcg. Copper is involved in the regulation of gene expression, brain development, neurotransmitters, cardiovascular health, and immune system functioning.

- Your genotype is associated with low serum levels of copper
- Copper is highest in liver (3 oz. 12,400mcg), oysters (4,850mcg), potatoes (675mcg), shiitake mushrooms (1/2 cup, 650mcg), cashew (1 oz., 629mcg), sunflower seeds (1/4 cup, 615mcg) and dark chocolate (1 oz., 615mcg)

Fiber Requirements



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

Phytoestrogens

Phytoestrogens are plant derived compounds found in a wide variety of foods. There are pros and cons to phytoestrogen intake that appears to have a genetic, age, and gut health connection for determining optimal intake.

- Your genotype combinations are associated with a low to average need for phytoestrogens for healthy hormones

Phytonutrient Requirements

Lutein and Zeaxanthin

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

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

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

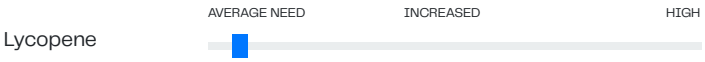
- Your genotype is associated with an average need for cinnamon to control blood sugar

Phytonutrient Requirements

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

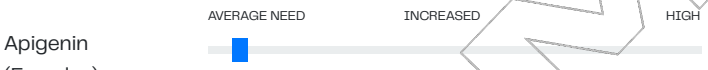
Phytonutrient Requirements



Lycopene is found in tomatoes, watermelon, guava and pink grapefruit, and has unique benefits for the heart, breast, prostate and skin.

- Your genotype combinations are associated with a lower to average requirement for lycopene

Phytonutrient Requirements



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

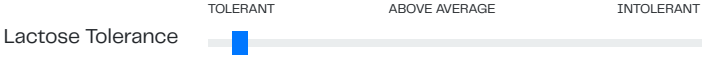
- Your genotype is associated with an average need for apigenin for breast health

Phytonutrient Requirements

Resveratrol is a plant chemical produced in response to stress from the elements, and has been found to protect against heart disease and potentially extend life.

- Your genotype combinations are associated with an average requirement for resveratrol and heart health

Lactose Tolerance



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

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

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METHYLATION

Methylation

Folate

AVERAGE NEED | INCREASED | HIGH

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

- Your genotype combination is associated with an average requirement for folate to maintain healthy homocysteine levels

Methylation

Folinic Acid

AVERAGE NEED | INCREASED | HIGH

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

AVERAGE NEED | INCREASED | HIGH

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 a higher than average requirement for B6 to maintain healthy methylation and homocysteine levels
- B6 is highest in wild salmon, wild cod, pistachios, avocados, Yukon gold or red potatoes, taro root, sweet potatoes, spinach, cauliflower and unfiltered fermented drinks
- Many medications deplete B6 including antibiotics, oral contraceptives, ACE inhibitors, antacids, and proton pump inhibitors

Methylation

Vitamin B12

AVERAGE NEED | INCREASED | HIGH

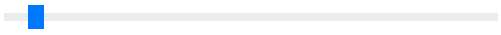
Vitamin B12 plays an important role in homocysteine metabolism.

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

Methylation

Riboflavin (B2)

AVERAGE PRIORITY | MEDIUM PRIORITY | HIGH PRIORITY



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

- Your genotype is associated with an average requirement for riboflavin to maintain healthy methylation and homocysteine levels

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

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HORMONE SUPPORT

Hormone Support

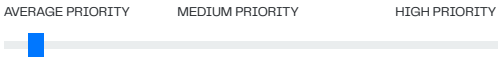
Breast Protection

Certain glutathione SNPs are associated with breast protection.

- Your genotypes for multiple genes are associated with slightly lower glutathione protection for breast health
- Boosting glutathione can be accomplished with selenium, glycine, cysteine, vitamin C, and cruciferous vegetables

Hormone Support

Estrogen Detoxification

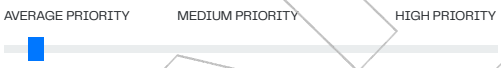


There are multiple genes in the estrogen detoxification pathway that have a cumulative value on the ability to properly detoxify estrogen.

- Your combination of numerous genotypes in the estrogen pathway are associated with improved estrogen detoxification

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

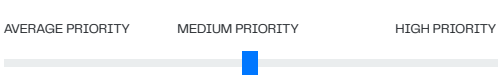
Adiponectin

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



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

MENTAL HEALTH & COGNITIVE PERFORMANCE

Mental Health and Cognitive Performance

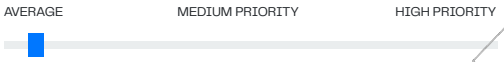
Brain Repair and Maintenance

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 slightly reduced neural repair, which can affect healing from brain injuries and amplify damage from poor sleep patterns
- Limit or avoid activities with a high risk of concussions
- Get eight hours of sleep per night for optimal repair
- Be proactive with neural repair by focusing on safe endurance exercise, DHA, B-vitamins, Lion's Mane mushroom, 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 improved recovery from concussions

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 an improved 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 a higher than average requirement for cardiovascular exercise to improve mood and cognitive fitness
- Research shows that at least 30 minutes of cardio, 5 times a week, is the target to hit for improved mood and cognitive fitness

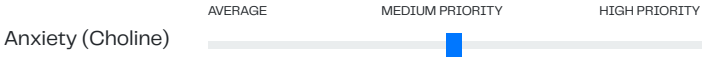
Mental Health and Cognitive Performance

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 MTHFR genotype combinations are associated with an average need (200-400mcg) of folate for healthy BH4 levels responsible for neurotransmitter balance

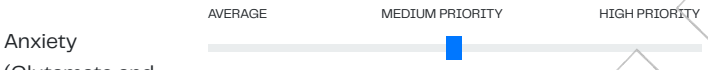
Mental Health and Cognitive Performance



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



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 reduce anxiety.

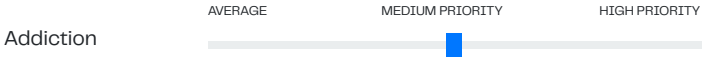
- Your genotype combination is associated with a reduced modulation of glutamate levels that could cause high glutamate and low GABA that could lead to anxiety
- Too much sugar and caffeine can create a high glutamate and low GABA mental state
- Cardio exercise, HIIT training and yoga have all been found to balance glutamate and GABA levels
- B6 and magnesium help convert excess glutamate to GABA (the calming neurotransmitter)
- Increase prebiotic intake to increase GABA levels and slow down an overactive mind at night to assist sleep

Mental Health and Cognitive Performance

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

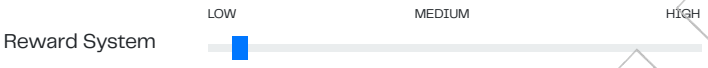
Mental Health and Cognitive Performance



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



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.

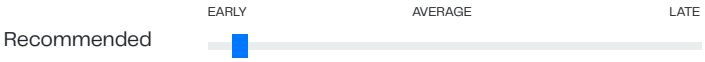
- Your genotype is associated with a lower dopamine response to reward processing that could negatively affect motivation and delay decision making
- Creating deadlines for short term tasks and long term goals can help create pressure and elevated dopamine levels to improve motivation and decision making
- 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

Warrior or 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

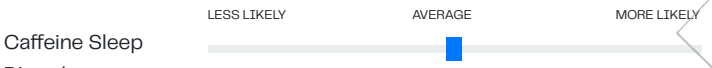


Recommended Wake Time

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 without light exposure
- Melatonin supplementation was not found to cause impaired glucose intolerance for your CC genotype

Sleep Support



Caffeine Sleep Disturbance

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

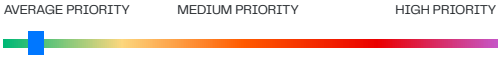
REM Sleep

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

Stress Management

Stress Perception

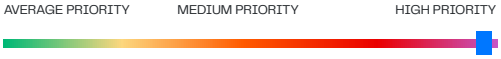


Your perception of stress is unique to your genotypes and life experience. Variants in 5-HT2A are associated with perceived stress, low vagal tone, anxiety, depression, OCD, and IBS, especially in females.

- Your genotypes are associated with a lower perception of stress.

Stress Management

Stress and Digestion



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

Cardio and Stress Relief

The 5-HT2A gene for the serotonin has a role in BDNF regulation – which helps regulate the excitatory neurotransmitter glutamate and calming neurotransmitter GABA. The A allele for 5-HT2A rs6314 was found to cause a lower expression of BDNF, and can compound the effect for those with variants in BDNF for mood and behavior in response to stress.

- Your genotype combination is associated with an increased susceptibility to low BDNF levels in response to stress, causing high glutamate and low GABA levels in the brain

Stress Management

Weight Training and Stress Relief

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

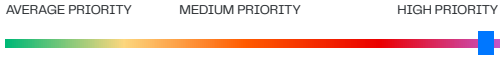
- Your genotype is associated with a lower level of dopamine and adrenaline, and weight lifting may have less of an impact on stress compared to other genotypes

US BioTek LABORATORIES

DETOXIFICATION

Toxin Sensitivity

Mycotoxins

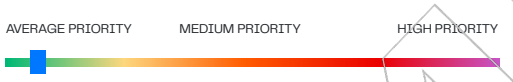


Mycotoxins are toxic compounds that are naturally produced by certain types of fungi. Research suggests that mycotoxins can decrease the formation of glutathione due to decreased gene expression of the enzymes needed to form glutathione.

- 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

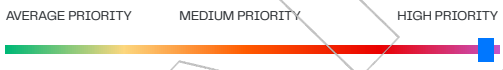
Formaldehyde

The International Agency for Research on Cancer has classified formaldehyde as carcinogenic to humans. Sources of formaldehyde in the home include building materials, smoking, household products, gas stoves, kerosene space heaters, as a food preservative, permanent-press clothes, and draperies, as a component of glues and adhesives, and as a preservative in some paints and coating products. Variants in the XRCC3 DNA repair gene have been associated with higher DNA damage from formaldehyde.

- Your genotype is associated with an increased sensitivity to formaldehyde
- Formaldehyde can cause watery eyes, burning sensations in the eyes and throat, nausea, and difficulty in breathing in some humans exposed at elevated levels
- Formaldehyde has also been shown to cause cancer in animals and may cause cancer in humans
- Average concentrations in older homes before the 1970's are generally well below 0.1 (ppm), but in homes with significant amounts of new pressed wood products, levels can be greater than 0.3 ppm
- The detoxification pathway for formaldehyde includes the thiol pathway, ribulose monophosphate pathway, and pterin dependent pathway
- B-vitamins, zinc, selenium, vitamin C, cysteine, glycine and glutamine all target these pathways and DNA repair to improve formaldehyde detoxification

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

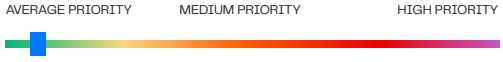
Aromatic Amines

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 slightly below average detoxification ability of aromatic amines
- If your exposure is higher to aromatic amines, increase cruciferous vegetable intake, carotenoids, vitamin C, and use marinades for meat when barbecuing

Toxin Sensitivity

Benzene



Sources of benzene include cigarette smoke, gasoline, exhaust, fires, industrial emissions, paint, detergent, glue, furniture wax, building materials, paint, petrochemical manufacturing, oil storage tanks, urban-industrial areas, service stations, certain foods, certain creams, groundwater contamination, and underground gasoline leaks.

- Your genotype is associated with an average sensitivity to benzene

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 increase 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

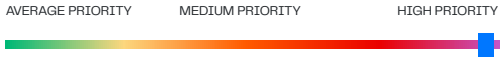
Organophosphate Insecticides

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
- Organophosphate 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

Arsenic

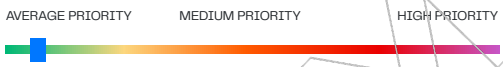


Arsenic is a heavy metal that is damaging at high levels. The highest dietary sources of inorganic arsenic include contaminated groundwater and rice. A consistent and growing body of evidence has shown that people who metabolize arsenic poorly may be at two to four times the risk of developing certain cancers and other arsenic-related diseases than people who are better metabolizers.

- Your genotype combination is associated with a reduced detoxification of arsenic
- The highest dietary sources of inorganic arsenic include contaminated groundwater and rice.
- Optimal selenium and folate intake have been found to improve arsenic detoxification and mitigate toxicity
- Chlorogenic acid – a polyphenol highest in light roast coffee – has been found to inhibit arsenic-induced neurotoxicity in mice
- Chlorogenic acid is also found in moringa tea, strawberries, cherries, bilberries, and wild blueberries

Pesticides, Herbicides and Heavy Metal Sensitivity

Cadmium

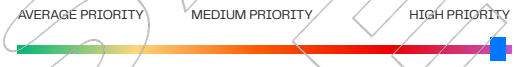


Chemical agriculture uses high amounts of synthetic organophosphates, creating a very high phosphorus content. Synthetic phosphorus concentrates the amounts of heavy metals, like cadmium in non-organic soils and food. Choosing organic produce is one of the best ways to avoid excess cadmium.

- 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 reduced detoxification and more toxic effects from elevated lead levels
- You may require more vitamin C and calcium if you are exposed to excess lead

IMMUNE SUPPORT, ANTIOXIDANTS AND INFLAMMATION

Bacteria, Yeast, Parasites and Viruses

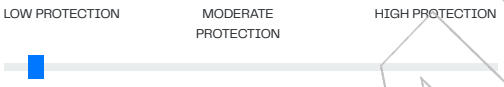
H. Pylori

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

Malaria



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

- Your genotype is associated with lower levels of thymidine, which may decrease lymphocyte replication and immune function in response to malaria
- The malaria parasite needs higher amounts of folate to survive and replicate
- For malaria-endemic regions, your genotype is associated with a higher susceptibility to malaria

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

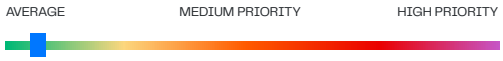
Bacteria, Yeast, Parasites and Viruses

DNA Viruses

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



SARS-CoV-2 Susceptibility

Genome-wide association studies have identified a region of chromosome 3p21.31 as the for conferring susceptibility to infection with LZTFL1 as the candidate gene. ApoE-e4, ACE2 and TMPRSS2 polymorphisms have been shown to be strongly associated with the susceptibility, severity, and clinical outcomes of COVID-19.

- Your genotype combination is associated with a reduced probability to SARS-CoV-2 infection
- Advanced age, obesity, and being male are considered the top risk factors for SARS-CoV-2 susceptibility, especially when combined with Type 2 diabetes, high blood pressure, and cardiovascular disease
- Research has shown that CBD, Chaga mushroom, birch bark and olive oil may stop SARS CoV-2 entry by helping block the "lock" for viral entry
- The flavonols kaempferol, quercetin, myricetin, fisetin and their derivatives were the most documented molecules with antiviral activities against SARS-CoV-2
- Propolis has antiviral activity and inhibitory effects on ACE2, TMPRSS2 and PAK1 signaling pathways used by SARS-CoV-2, while promoting immunoregulation of pro-inflammatory cytokines, and reducing the risk of cytokine storm syndrome

COVID-19

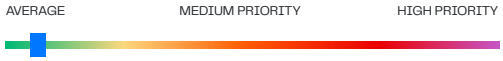
COVID-19 Viral Severity

ACE2 (the receptor for SARS-CoV-2) is reduced in individuals that are carriers of ApoE4. Once the virus fuses with the cellular membranes, it takes control, shuts down more ACE2 receptors, closing the door behind it. Fewer ACE2 receptors lead to elevated angiotensin II levels, which increases the viral load. This leads to a more severe infection, NF-kb activation, lung damage, and viral replication.

- An analysis of your ApoE genotype and numerous genes involved in the viral inflammatory pathways show an association with a reduced risk of viral severity
- The risk of viral severity can still be increased by existing health issues including Type 2 diabetes, obesity, high blood pressure, and cardiovascular disease
- In September 2020, Boston University found that SARS-CoV-2 is highjacking the NF-kB pathway and should be a target for suppressing viral aggressiveness
- In addition to vaccination, NF-Kb inhibitors can be both preventative for inflammation and successful with slowing viral aggressiveness
- These include vitamin C, vitamin D, zinc, selenium, magnesium, cordyceps mushrooms, resveratrol, triterpenoids (Chaga, reishi, olive oil, holy basil), caffeic acid (coffee, Chaga, elderberry), and anthocyanins (elderberry, goji berries, cacao)
- The dietary flavonols kaempferol, quercetin, myricetin, fisetin were the most documented molecules with antiviral activities against SARS-CoV-2, and had a broad spectrum of biological activities that could reduce the severity of infection symptoms and enhance the immune response
- The strong association between air pollution exposure and COVID-19 mortality suggests that inhaled noxious particles influence COVID-19 outcomes

COVID-19

COVID-19 Lung Damage Severity



Scientists at the University of Oxford published results in November 2021 that variants in the LZTFL1 gene doubles the risk of lung failure and death from COVID-19. Approximately 60% of people with South Asian ancestry, 15% of people with European ancestry, 2% of people with African-Caribbean ancestry and 1.8% of people with East Asian ancestry carry the high-risk variant. Scientists found that the LZTFL1 gene high-risk variant affects the lungs, but does not have an impact on the immune system.

- Your genotype is not associated with an increased risk COVID-19 related lung damage severity

COVID-19

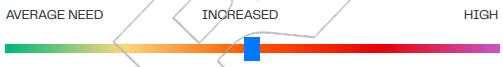
Glutathione

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



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

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

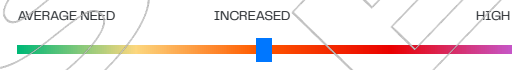
Vitamin D

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
- A 2021 study found that those with the GG genotype for CYP2R1 were associated with 5.9 higher odds of experiencing severe COVID-19
- 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



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 a higher than 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

Zinc

Optimal status of zinc is essential for the proper operation of the immune system and regulates NF-kb, where zinc deficiency in the setting of severe infection provokes a systemic increase in NF-kB activation. In vitro approaches have shown that zinc can inhibit SARS-CoV-1 replication.

- Your genotype is associated with an average serum zinc
- Scientific evidence supports that optimal zinc intake or supplementation should be considered part of the strategy to reduce COVID-19 effects, with early reports finding that 15-23mg a day show significant improvement in symptoms

COVID-19

Copper

Copper plays a key role in optimal performance of relevant components of the immune system, such as NK cells, macrophages, neutrophils, and monocytes. A deficiency has been related to less effective immune responses against infections, vulnerability for the heart and blood vessels to damage, and increased virulence. Excessive intake is also associated with negative immune function.

- Your genotype is associated with lower serum copper

COVID-19

Iron

Suboptimal levels of iron are associated with decreased killer efficiency of NK cells and lymphocytes as well as with compromised cytokine production. Both iron uptake disturbances and metabolism are implicated in virulence of airway hospital-acquired infection and chronic respiratory infections. In contrast, excessive iron levels can generate harmful cellular toxicity, so their serum levels must be well regulated.

- Your genotype combination is associated with average serum iron levels
- A retrospective study based on 50 hospitalized Chinese subjects with confirmed COVID-19 demonstrated that 90% of these subjects had abnormally low serum iron concentrations
- Populations with lower iron status could be more prone to suffer a mild to severe (or critical) symptomatology of COVID-19 and the fact of monitoring patient iron levels has been proposed as a potential early marker to predict COVID-19 severity and mortality
- Iron levels should always be monitored by your practitioner

COVID-19

B12

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 low serum B6 levels, requiring a higher than average intake of B6
- 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.

- You have the rare genotype for increased type 1 collagen production that may reduce your glycine requirement

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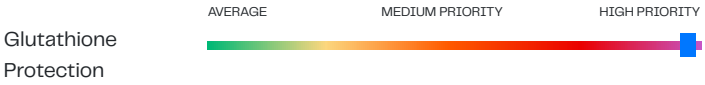
DNA PROTECTION & REPAIR

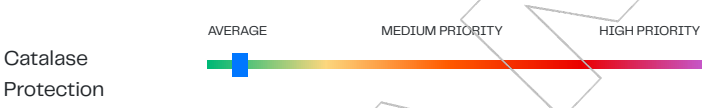
DNA Protection & Repair



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

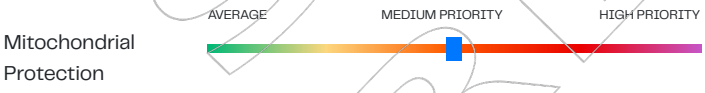
DNA Protection & Repair



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



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

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 reduced 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

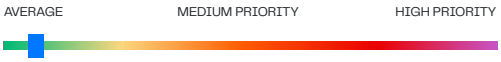
Skin Protection

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

- Your genotype is associated with slighly lower antioxidant protection for the skin
- Vitamin C, niacin, zinc, selenium, dandelion root, ashwagandha, and dark roast coffee have all been found to reduce the risk of melanoma

DNA Protection & Repair

Lung Protection

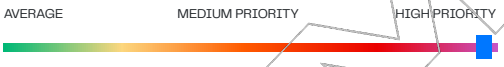


Variants in the GSTP1 gene have been associated with lower antioxidant support in the lungs when exposed to environmental pollution.

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

DNA Protection & Repair

Lung Protection (Asian Ancestry)



Glutathione levels and pro-inflammatory cytokines, such as TNF-a, are found in airways and environmental pollutants are known to induce inflammatory responses.

- Your genotype combination is associated with reduced lung protection against environmental pollutants
- It is recommended to increase your intake of cruciferous vegetables, vitamin C, vitamin E, vitamin A, milk thistle, resveratrol, curcumin, green tea, and white tea to target the GSTM1 gene
- Additional support includes cold water immersion, breathing exercises, cordyceps, and ginger to target the TNFA gene

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

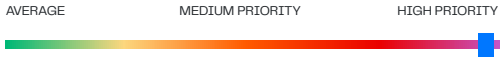
Pancreas Protection

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

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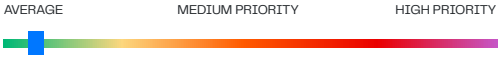
CARDIOVASCULAR HEALTH & EXERCISE

Cardiovascular Health

HDL and LDL

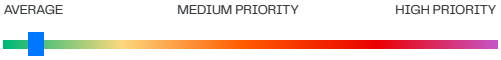


ApoE is connected to HDL and LDL levels, while PON1 is involved with supporting HDL function and LDL oxidation, an important mechanism in atherosclerosis and heart disease.

- 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 not associated with a higher proportion of small, dense LDL particle size

Cardiovascular Health

Triglycerides

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

- Your genotype is not associated with elevated triglycerides

Cardiovascular Health

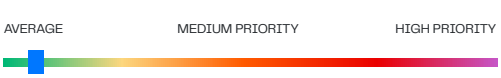
ApoB

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 not associated with elevated ApoB levels

Cardiovascular Health

Lp(a)

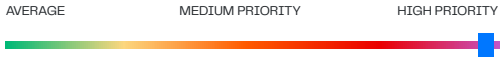


Lp(a)is a sticky form of LDL that appears to affect plaque growth, LDL particle size and increase the risk of plaque rupture and blood clotting.

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

Cardiovascular Health

Raw Plant Intake

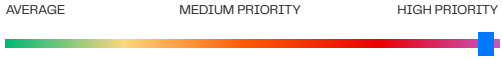


The risk of heart attacks and cardiovascular disease conferred by the 9p21 gene appears to be modified by a prudent diet high in raw vegetables and fruits for South Asian, Latin American, Arab, Chinese and European populations for variants in rs4977574.

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

Cardiovascular Health

Nitric Oxide



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

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 an average need for folate to maintain healthy homocysteine levels

Cardiovascular Health

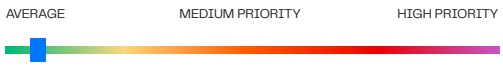
High Blood Pressure

Age-related increases in blood pressure have been observed in almost every population, except among hunter-gatherers and farmers. High physical activity, low-stress levels, and potentially protective diets high in fruits, vegetables, potassium, lower in calories, salt, and alcohol are the major contributing factors to the stark differences.

- Your genotype combination is associated with normal blood pressure levels

Cardiovascular Health

Blood Clots

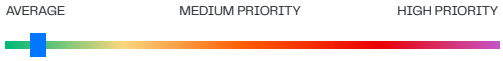


Deep vein thrombosis is a condition that occurs when a blood clot forms in a vein deep inside a part of the body and is most common for those over 60. Variants in F5 increase the risk of deep vein thrombosis.

- Your genotype is not associated with deep vein thrombosis

Cardiovascular Health

Uric Acid

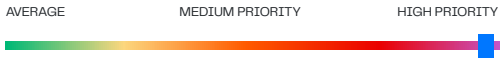


Variants in the ABCG2 gene have been associated with elevated uric acid levels and an increased risk of gout in Asians, Europeans, African Americans, Mexican Americans, and American Indians. Epidemiological studies have shown that uric levels are positively correlated with gout, hypertension, atherosclerosis,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

- Your genotype is associated with average uric acid levels

Cardiovascular Health

Fibrinogen



Fibrinogen is a soluble protein in the plasma that is broken down to fibrin by the enzyme thrombin to form clots. Fibrinogen serves to stop excessive bleeding, but in high amounts can cause blot clots.

- Your genotype is associated with elevated fibrinogen levels
- Avoid BPA plastic, unfiltered tap water, and phthalates (chemical personal care products)
- Increase the probiotic lactobacillus planatarum and discuss the use of nattokinase with your health practitioner if fibrinogen levels are elevated

Cardiovascular Health

Hemochromatosis

A homozygous HFE C282Y may lead to an iron overload due to increased iron absorption and disrupted metabolism. People who are homozygous for the HFE C282Y gene mutation comprise 85 to 90 percent of those with hemochromatosis 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 RX genotype for the ACTN3 gene associated with enhanced improvements in strength, power and muscle hypertrophy
- More powerful muscle contractions
- Higher muscle hypertrophy response
- Faster recovery

Exercise

Weight Lifting Inflammation

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

- Your gene combination is associated with lower levels of muscle inflammation (creatine kinase) for weight lifting that improves recovery time

Exercise

Endurance Exercise Inflammation

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

- Your gene combination is associated with lower levels of muscle inflammation (creatine kinase) for endurance exercise that improve recovery time

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

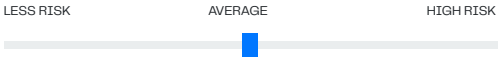
ACL and Shoulder Dislocation Risk

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

- You have the rare COL1A1 genotype that is associated with a decreased risk of ACL and shoulder injuries due to improved collagen production

Exercise

Ankle and Hamstring Injury Risk

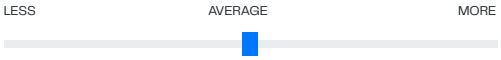


The ACTN3 gene is linked to increased or decreased risk of ankle and hamstring injuries.

- Your ACTN3 genotype is associated with an average risk of ankle and hamstring injuries

Exercise

Cold Endurance



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

- You have the ACTN3 RX genotype, associated with an average adaptation rate to cold endurance

Exercise

VO2 Max Trainability

VO2 max is measurement for oxygen capacity and endurance training. The most recent research has shown that 97 genes predicted VO2 max trainability. The phenotype is dependent on several of these variants combined together, which may contribute to approximately 50% of an individual's VO2 max trainability.

- Research has shown that your genotypes for multiple genes are associated with a higher VO2 max training response

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

TEST METHODOLOGY AND LIMITATIONS

Recommendations in this report apply to all ages, however for any patient under 18 years, a guardian must purchase the test and be present for the report recommendations. The information in this report is not intended to treat, diagnose or cure any medical condition or disease.

The test has not been cleared or approved by the FDA. FDA does not require this test to go through premarket FDA review. The test is used for clinical purposes. It should not be regarded as investigational or for research. Only the genomic regions listed below were tested; there is a possibility that the tested individual is a carrier for additional, undetected mutations. Although molecular tests are highly accurate, rare diagnostic errors may occur that interfere with analysis. Sources of these errors include sample mix-up, trace contamination, and other technical errors. The presence of additional variants nearby may interfere with mutation detection. Genetic counseling is recommended to properly review and explain these results to the tested individual.

Gene By Gene, a wholly owned subsidiary of myDNA, Inc., is a College of American Pathologists (CAP) accredited and Clinical Laboratory Improvement Amendments (CLIA) certi ed clinical laboratory qualifed to perform high-complexity testing. This test was developed and its performance characteristics determined by Gene by Gene.

MY HEALTH REPORT: 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!

NUTRIENT METABOLISM & DIGESTION

- **ALA to EPA and DHA Conversion-FADS2** - Your genotype is associated with an improved conversion of plant-based omega-3 ALA (walnuts, flax seeds, pumpkin seeds) to EPA and DHA.
- **Prebiotics, Probiotics and B12-FUT2** - The rs601338 FUT2 AG genotype in European, African, and Indian populations is associated with intermediate B12 levels and 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.
- **Adiponectin-ADIPOQ** - Your genotype is associated with a higher probability of normal adiponectin levels, linked to improved bodyweight, insulin, and glucose levels.
- **Iron** - Your genotype is associated with a lower risk of iron overload for the HFE C282Y gene.
- **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.
- **Histamines-AP81** - You have the wild-type genotype that is associated with improved histamine breakdown in the digestive tract.
- **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-MTHFR 677** - You have the wild-type genotype common in northern climates. This genotype is associated with lower folate requirements unless you have the MTHFR 1298 homozygous genotype. The wild-type MTHFR 677 genotype assists with healthy homocysteine levels.
- **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.
- **Arsenic-CBS** - Your genotypes are associated with improved arsenic metabolism and detoxification for the CBS genes.

HORMONE SUPPORT

- **Thyroid-DI01** - Your genotype is associated with average DI01 gene function for T3 and T4 thyroid function, however other epigenetic factors should be assessed.
- **Thyroid-DI02** - Your genotype is associated with average T3 and T4 thyroid function in the brain for the DI02 gene. However, other factors can affect T3 and T4 levels including thyroid surgeries.
- **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-CYP2C19** - Individuals with the T allele for CYP2C19*17 are considered the ultra-rapid metabolizer phenotype. This may positively add to the cumulative value for improving 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 heterozygous genotype is associated with improved bifidobacteria gut bacteria, assisting the gut phase of estrogen detoxification.
- **MTNR1B-Melatonin** - You have the CC MTNR1B genotype, which is associated with a normal circadian rhythm of melatonin production at night and in the morning. This gives you a wider time range for breakfast and dinner for glycemic control.

MENTAL HEALTH, NEUROTRANSMITTERS & COGNITIVE PERFORMANCE

- **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.
- **Serotonin Receptor-Stress** - You may have improved function for the serotonin receptor gene connected to perceived stress and the ability to regulate chronic stress. This may reduce the probability of low vagal tone, anxiety, depression, and obsessive and compulsive thoughts related to dysregulated serotonin levels.
- **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.
- **Glutamate Transport-SLC17A7** - Your genotype is associated with improved recovery from head injuries. However, your APOE and BDNF genotype should also be assessed because these all have a cumulative impact.
- **Cholesterol-APOE** - You have the ApoE e3/e3 genotype, improving cholesterol transport and the maintenance of brain neurons. The ApoE e3 allele improves cognitive fitness, HDL and LDL profiles, viral protection, and the response to plant bioactive compounds.

IMMUNE SUPPORT, ANTIOXIDANTS AND INFLAMMATION

- **Cell Protection-CAT** - Your genotype is associated with improved catalase levels, mitigating damage to your cells.
- **Glutathione-GSTM1** - While the GSTM1 null genotype has been associated with a greater sensitivity to benzo(a)pyrene, there is also a benefit to this genotype. The benefit is that the null genotype may retain a higher level of isothiocyanates, the anti-cancer compounds found in cruciferous vegetables that may also be required in higher amounts for this genotype.
- **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-NOS1** - Your genotype is associated with an average required intake of red, yellow, and orange vegetables to modulate the inflammatory process for NOS1.
- **Nitric Oxide-NOS2** - Your NOS2A gene is functioning optimally for reducing the probability of age-related macular degeneration from cigarette smoke.

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-CYP2D6** - Your genotype is associated with improved metabolism 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.
- **Liver Enzyme-CYP2E1** - Your genotype is associated with improved metabolism of benzene and acrylamide for colon health.
- **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.
- **Aromatic Amines-NAT2** - You have the intermediate acetylator genotype for NAT2, which is associated with a reduced risk of bladder cancer in smokers and may improve the detoxification of aromatic amines found in commercial hair dyes, industrial and manufacturing plants, meat cooked at high temperatures, and diesel exhaust.
- **Statins-COQ2** - Your genotype is associated with a lower likelihood of statin drug-induced muscle pain.

DNA DAMAGE, PROTECTION AND REPAIR

- **DNA Repair-ATM** - Your genotype is associated with improved DNA repair function for pancreatic health.
- **Breast-ESR2** - For women with the AA ESR2 rs2987983 genotype, your genotype is associated with improved tumor suppression function for breast health. All genes related to breast health should be analyzed to better determine the cumulative value for breast protection.
- **DNA Repair-MLH1** - Your genotype is associated with improved DNA repair for colon, endometrium, lung, and brain protection.
- **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 & EXERCISE

- **Power and Recovery-ACTN3** - You have the RX genotype associated with enhanced improvements in strength, muscle hypertrophy, sprint times, protection from eccentric training-induced muscle damage, and a reduced risk of sports injury. The RX genotype may represent the best of both ACTN3 genotypes for strength training, maintaining lean muscle mass later in life, and longevity.

- **VO2 Max-PPARGC1A** - Your genotype is associated with a higher oxygen capacity for endurance exercise. Your genotype in the GSTP1 rs1695 gene can also influence this result.

- **Muscle Recovery-IL6** - You have the GG genotype that is associated with lower levels of muscle inflammation post-exercise and improved recovery, faster sprint times, and is more common in sprint and power athletes compared to endurance athletes.

- **Muscle Injury-COL1A1** - You have the rare AA genotype (5% of the population) that is associated with a decreased risk of tendon and ligament injuries due to improved collagen production. Type 1 collagen is also connected to healthy skin, tendons, corneas, lungs, and bones.

- **LDL-LPA** - Your genotype is associated with healthy Lp(a) levels, a sticky form of LDL that affects plaque levels.

- **Triglycerides-FADS1** - You have the wild-type CC genotype that is associated with lower triglycerides.

- **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.

- **Potassium and Magnesium-ADD1** - If you have Asian ancestry, your wild-type genotype is associated with a reduced risk of a higher sodium intake causing elevated 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.

- **Phytoestrogens-TMPRSS2** - You have the AG genotype that is associated with a lower expression of TMPRSS2 and may decrease the susceptibility to viral infections and prostate cancer (men).

MY HEALTH REPORT: WEAKNESSES

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!

NUTRIENT METABOLISM & 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.
- **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.
- **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.
- **Stress and IBS-ADRB2** - You have the ADRB2 homozygous GG genotype that is associated with a higher percentage of digestive disorders, IBS, and anxiety from 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.

METHYLATION

- **Folate-MTHFR 677** - You have the wild-type genotype that is associated with reduced protection against UV-induced DNA damage from the sun due to lower thymidine production.
- **Folate-MTHFR 1298** - You have the homozygous genotype that is associated with an estimated 40% reduction in enzymatic function. More focus should be on folate, vitamin C, L-arginine, B6, magnesium, holy basil, selenium, royal jelly and deep breathing techniques to improve gene function.
- **Folate-MTHFD1 G1958A** - Your genotype is associated with an increased need for folinic acid, the second most common type of folate after methylfolate.
- **B12-TCN2** - Your B12 transportation may be affected if lithium levels are low due to your genotype in the TCN2 gene.
- **Choline-PEMT** - Your genotype is associated with an increased need for dietary choline for liver health, normal homocysteine levels, breast health for women, and a healthy pregnancy for women.
- **B6-CBS** - Your genotype is associated with reduced CBS gene function for homocysteine levels, gut repair, and brain health, increasing your need for B6.

HORMONE SUPPORT

- **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-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.

MENTAL HEALTH, NEUROTRANSMITTERS & COGNITIVE PERFORMANCE

- **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.

- **Brain Health-PEMT** - Your genotype is associated with an increased need for dietary choline and daily walks for memory, anxiety, and REM sleep.

- **Glutamate-BDNF** - Your genotype is associated with lower BDNF levels that can affect mood, head injury recovery, memory, and blood sugar levels. Research has shown that running, DHA, lithium, green tea, milk thistle, acetylcholine, sunlight, saunas, hot baths, the probiotic Bifidobacterium longum, intermittent fasting, turmeric, and optimal estrogen levels (women) all improve BDNF levels.

IMMUNE SUPPORT, 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-GSTM1** - You have the null genotype that is associated with a higher sensitivity to benzo(a)pyrene from the burning of wood or trash, tobacco smoke, asphalt, coal, diesel exhaust, charred meat, and gas cooking. If you have the GSTM1 null and NAT2 slow acetylator combination, that may affect lung, breast, bladder, skin, colon, and kidney health. It is recommended to increase your intake of cruciferous vegetables, vitamin C, vitamin E, vitamin A, milk thistle, resveratrol, curcumin, green tea, and white tea.

- **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.

- **Eye Health-CFH** - Your genotype is associated with an increased need for lutein, zeaxanthin, bilberry, lingonberry, vitamin C, and vitamin E for healthy eyes.

- **Eye Health-ARMS2** - Your genotype is associated with a higher sensitivity to the negative effects of smoking on eye health.

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.

- **Vitamin K2-VOKRC1*2** - Your genotype is associated with a higher sensitivity to vitamin K2 induced deficiency from antibiotics and the blood thinner Warfarin.

DNA DAMAGE, PROTECTION AND REPAIR

- **DNA Repair-TP53** - You have the heterozygous CG 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.
- **DNA Repair-MDM2** - Your MDM2 genotype is associated with a higher sensitivity to sun damage and lower Tp53 levels if you are female.
- **Processed Meat and Colon Cancer-GATA3** - Your genotype is associated with a sensitivity to processed meats (hot dogs, salami, pepperoni) and colon cancer risk due to variants in GATA3. Reduce processed meat intake, optimize vitamin D levels and increase berries, apples, sauerkraut, broccoli, tomatoes, basil, rosemary, garlic, onions and leeks.

CARDIOVASCULAR HEALTH & EXERCISE

- **Lung Cytokines-TNFA** - If you have Asian ancestry, your genotype is associated with a higher risk of lung inflammation due to elevated TNF-a levels. You can improve TNF gene function from cold water immersion, breathing exercises, cordyceps, vitamin C, turmeric, and ginger, which have all been found to lower TNF-a levels.
- **Pesticides, HDL and LDL-PON1** - Your genotype is associated with decreased PON1 gene activity and reduced pesticide detoxification that could affect LDL oxidation. Elevated mercury levels and high homocysteine can further negatively affect PON1. There are numerous strategies to improve PON1 including choosing organic foods, adequate calcium and magnesium, pomegranates, broccoli sprouts, high-quality olive oil, and a glass of red wine.
- **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.
- **Fibrinogen-ESR2** - Your genotype is associated with potentially elevated fibrinogen (increased risk of blood clots) levels in postmenopausal women. This increases the need to avoid BPA plastic, unfiltered tap water, and phthalates (chemical personal care products). Increase the probiotic lactobacillus planatarum and discuss the use of nattokinase with your health practitioner if fibrinogen levels are elevated.

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

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

Betaine — Spinach, shrimp, beets, and whole grain sourdough bread

Copper — Potatoes, shiitake mushrooms, cashews, sunflower seeds, dark chocolate, and shellfish

Glucosinolates — Brussels sprouts, mustard greens, turnips, savoy cabbage, kale, watercress, red cabbage, broccoli cauliflower, and Bok Choy

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

Lithium

Mineral water, shellfish, tomatoes, spinach, unpeeled potatoes, eggplant, cabbage, rooibos tea, rosehips, pastured eggs and Saccharomyces cerevisiae (yeast)

Lutein and Zeaxanthin

Cooked spinach, cooked kale, raw spinach, raw parsley, goji berries, asparagus, and eggs

Manganese

Mussels, wild blueberries, hazelnuts, pecans, oysters, clams, hummus, spinach, and cultivated blueberries

Polyphenols

Coffee, green tea, kombucha, blueberries, strawberries, raspberries, blackberries, and cacao

Resveratrol

Red grapes, peanut butter, Itadori tea, and dark chocolate

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

Vitamin K2

Natto, pastured eggs, aged cheeses (if consuming dairy), dark chicken meat, and pork chops

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.

B12

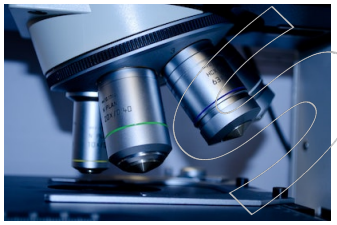
If poor B12 status is suspected, methylmalonic acid (MMA) levels may be needed to accurately assess B12 status, absorption, and requirements

Fasting Glucose and HbA1C

Check both fasting glucose and HbA1C

Homocysteine

Homocysteine should be between 7-9



Vitamin D

Vitamin D should be between 35-50 ng/ml. Check both 25 and 1,25-dihydroxyvitamin D.

MY CLINICAL RESEARCH SUMMARY: NUTRIENT METABOLISM & DIGESTION

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.

B6-NBPF3

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
NBPF3 rs4654748	Heterozygous CT

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 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.

Protein and Fat-ACAT

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
ACAT1-02 rs3741049	Heterozygous AG

Recap

Improves ACAT Gene Function: B-vitamins 1-5 and lipoic acid.

Decreases ACAT Gene Function: Medications that deplete B-vitamins 1-5, excess coffee, flour based foods, excess alcohol and excess sugar.

PROTEIN AND FAT-ACAT

Improves ACAT Gene Function: B-vitamins 1-5 and lipoic acid.

Decreases Gene Function: Medications that deplete B-vitamins 1-5, excess coffee, flour based foods, excess alcohol and excess sugar.

Research: The ACAT gene converts protein and fat to ATP(energy) in the mitochondria, and plays an important role in cellular cholesterol levels. The heterozygous or homozygous ACAT-02 may cause issues with protein and fat metabolism if B-vitamin deficiency is induced.

This gene requires adequate B-vitamins 1-5 and alpha lipoic acid. If you have habits that deplete B-vitamins (medications, excess coffee, flour based foods, excess alcohol, sugar), more stress may be put on the ACAT enzymes and create poor digestion of fat and protein.

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 was more insulin resistant. Among individuals within the top 50th percentile of PUFA intake, the metabolic syndrome risk associated with GG genotype 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.

Stress and IBS-ADRB2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
ADRB2 rs1042714	Homozygous GG

Recap

Increases ADRB2 Gene Function: Deep breathing techniques, meditation, yoga, magnesium, and vitamin C.

Decreases ADRB2 Gene Function: Chronic stress and shallow breathing.

STRESS AND IBS-ADRB2

The pathogenesis of digestive disorders is incompletely understood, although genetic factors, low-grade inflammation, intestinal dysbiosis, abdominal pain, and brain-gut axis dysfunction all have been postulated to contribute.

The beta-2-adrenergic receptor (ADRB2) is the main target of the catecholamine epinephrine and a primary mediator of the stress response. ADRB2 is widely expressed both in the gastrointestinal tract and in the CNS.

Single-nucleotide polymorphisms (SNPs) located in the coding region of the ADRB2 gene have been shown to be associated with increased altered receptor response to catecholamines as well as altered receptor expression. In the case of rs1042714, this may lead to decreased receptor degradation and down-regulation, in turn enhancing the adrenaline response.

For the rs1042714 genotype, both GG homozygotes and CG heterozygotes demonstrated a higher percentage of digestive issues compared with CC homozygotes. The G allele carriers were associated with a higher percentage of IBS cases, twice the rates of anxiety, and functional chest pain diagnoses. Within IBS, G allele carriers had more severe bowel symptoms and symptomatic days.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
HLA-DQ8	HLA-DQ8-rs7454108	TT		
HLA DQ2.5	HLA DQ2.5-rs2187668		CT	
BCMO1 A379V BCMO1 encodes the conversion rate from beta-carotene to vitamin A.	BCMO1 A379V-rs7501331	CC		
	BCMO1 R267S-rs12934922		AT	
FADS2 The FADS2 gene encodes the conversion of plant based omega-3 fatty acid alpha linolenic acid (ALA) to EPA.	FADS2-rs1535	AA		
	FADS2-rs174575	CC		
FUT2 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		AG	
NBPF3 NBPF3 has been associated with vitamin B6 levels.	NBPF3-rs4654748		CT	
SLC23A1 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 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		AG	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
ADIPOQ 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	TT		
HFE-C282Y A homozygous HFE C282Y may lead to an iron overload due to increased iron absorption and disrupted metabolism. Compound heterozygotes C282Y/H63D and single C282Y heterozygotes carry a very low risk of hemochromatosis, making the homozygous C282Y the most clinically relevant.	HFE-C282Y-rs1800562	GG		
PPAR-alpha 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 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 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-rs17817449		GT	
	FTO-rs9939609		AT	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
APOA2 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 TCF7L2 polymorphisms have been associated with low incretin hormones and impaired insulin secretion.	TCF7L2-rs7903146	CC		
LCT LCT is the gene connected with the ability to breakdown lactose in dairy.	LCT-rs4988235			AA
APB1 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	CC		
ABCG2 (Q141K) 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		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
ALDH2 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		
ADRB2 The beta-2-adrenergic receptor (ADRB2) is the main target of the catecholamine epinephrine, and a primary mediator of the stress response. ADRB2 is widely expressed both in the gastrointestinal tract and in the CNS.	ADRB2-rs1042714			GG
PPCDC PPCDC is necessary for the biosynthesis of coenzyme A and variants in this SNP are associated with serum zinc levels.	PPCDC-rs2120019	TT		
SELENBP1 The Protein Selenium Binding 1 gene codes for an integral membrane protein involved in antigen presentation and serum copper levels.	SELENBP1-rs2769264	TT		
TFR2 The TFR2 gene provides instructions for making a protein called transferrin receptor 2 to help iron enter liver cells. The receptor on the surface of liver cells binds to transferrin, which transports iron through the blood to tissues throughout the body. When transferrin binds to transferrin receptor 2, iron is allowed to enter the cell.	TFR2-rs7385804		AC	

MY CLINICAL RESEARCH SUMMARY: METHYLATION CYCLE

Folate-MTHFR 677

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
MTHFR 677 rs1801133	Wild Type GG

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

You have the wild-type genotype common in northern climates. This genotype is associated with lower folate requirements unless you have the MTHFR 1298 homozygous genotype. The wild-type MTHFR 677 genotype assists with healthy homocysteine levels.

The wild-type genotype is associated with reduced protection against UV-induced DNA damage from the sun due to lower thymidine production.

Folate-MTHFR 1298

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
MTHFR 1298 rs1801131	Homozygous GG

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 homozygous MTHFR 1298 gene has a 40% reduction in enzymatic function.

MTHFR 677 and 1298 are connected to BH4 levels, with individuals who are homozygous having a much higher sensitivity to the drain on BH4 from stress, heavy metals, high blood sugar, vegetable oils, chronic stress, high levels of mercury, arsenic, lead and aluminum, synthetic folic acid, phenylalanine, aspartame, oxidative stress and high protein diets.

BH4 structurally resembles folate and has been described to be reduced in endothelial cells when increased levels of homocysteine are present. High protein diets produce higher amounts of ammonia, which drains BH4, and the body stores ammonia as glutamate, compounding issues with the GAD1 genes). This can lead to an individual with higher anxiety levels, especially those with elevated glutamate levels.

The heavy metal sensitivity may be why men with the homozygous MTHFR 1298 genotype have a statistically higher significance of infertility. Tulsi (holy basil) has also been shown to protect against the toxic effects of heavy metals such as lead, arsenic, cadmium, chromium and mercury, and the toxic effects of radiation.

BH4 plays an important role in the formation of all the neurotransmitters (serotonin, melatonin, dopamine, epinephrine, norepinephrine etc.) and immunity. Mice studies have shown that raising BH4 normalizes serotonin levels and digestive function. In one human study, levels of BH4 in cerebrospinal fluid was 42% lower in children with Autism Spectrum Disorder (ASD).

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.

Research has found that vitamin C, L-arginine, folate, B6, magnesium, holy basil, selenium, royal jelly and deep breathing techniques all increase BH4 levels.

Relaxation techniques (yoga, meditation, Qi Gong) involve slow, deep breathing and have been found to be an effective therapeutic intervention that counteracts the adverse clinical effects of stress in disorders including hypertension, anxiety, insomnia and aging.

Folate-MTHFD1 G1958A

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
MTHFD1 G1958A rs2236225	Homozygous AA

Recap

Improves MTHFD1 Gene Function: 5-formyl-tetrahydrofolate (folinic acid) and choline

Decreases MTHFD1 Gene Function: Folate and choline deficiency, proton pump inhibitors, oral contraceptives, NSAIDs, anticonvulsants, antivirals, antibiotics, and acid blockers/antacids.

FOLATE-MTHFD1 G1958A

Research: A meta-analysis strongly suggests that the MTHFD1 G1958A polymorphism might be associated with maternal risk for neural tube defects in Caucasian populations. However, the evidence of this association should be interpreted with caution due to the selective nature of publication of genetic association studies. Another study found that the polymorphism decreases enzyme stability and increases risk of congenital heart defects.

5-formyl-tetrahydrofolate is the second most common type of folate after methylfolate in the certain foods. This is why dietary folate is optimal because it addresses both upstream and downstream folate gene polymorphisms in the methylation cycle.

Checking MTHFR and PEMT genes along with MTHFD1 helps you determine your requirements for folinic acid, methylfolate and choline to help stabilize enzymatic function.

B12-TCN2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
TCN2 C766G rs1801198	Homozygous GG

Recap

Improves TCN2 Gene Function: Lithium.

Decreases TCN2 Gene Function: Depleted lithium levels.

B12-TCN2

Research: Low vitamin B12 concentrations in the cell can be the result of low vitamin B12 intake, but they can also be attributable to a disturbance in the absorption, transport, or cellular uptake of this vitamin. High B12 levels on blood tests may indicate poor intracellular transport and absorption.

Approximately 20-25% of circulating cobalamin binds to transcobalamin 2 (TCN2), which is referred to as active vitamin B-12. A 2017 meta-analysis found that subjects with the rs1801198 GG genotype had significantly lower concentrations of holotranscobalamin and higher concentrations of homocysteine (European descent only) than subjects with the CC genotype.

In Chinese patients, the CG and GG genotypes were higher in patients with mild, moderate, and severe ulcerative colitis compared with those with remission ulcerative colitis. The average homocysteine level was elevated, whereas the average vitamin B12 and folate levels were reduced.

If you have the GG TCN2 genotype, you may require more dietary lithium to assist B12 transport. Lithium ranges widely based on the water supply. It is highest in certain mineral waters, shellfish, tomatoes, spinach, unpeeled potatoes, eggplant, cabbage, rooibos tea, rosehips, pastured eggs and Saccharomyces cerevisiae (yeast). Countries that consume the most lithium include the inhabitants of China, Mexico, Austria, and Sweden.

Testing lithium levels may be a useful marker for certain disorders like depression and bipolar disorder. One study found that young US children with autism and their mothers had unusually low levels of lithium compared to neurotypical children and their mothers.

Researchers have also explored lithium's role in preventing cancer metastasis when cancer cells are expressing high levels of TGFBIp. Inhibition of TGFBIp expression in cancer cells by lithium decreased tumor metastasis to the lungs, liver, and lymph nodes.

Be aware that high B12 supplementation depletes lithium levels, and dosing lithium supplementation should be done with extreme caution due to its suppressing effect on the thyroid hormones.

Choline-PEMT

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
PEMT rs7946	Heterozygous CT
PEMT rs12325817	Wild Type CC

Recap

Improves PEMT Gene Function: Choline, vitamin C and estrogen.

Decreases PEMT Gene Function: Nighttime pain relievers, antihistamines, anti-seizure medications, sleep aids, antidepressants, incontinence drugs and narcotic pain relievers.

CHOLINE-PEMT

Improves PEMT Gene Function: Choline, vitamin C and estrogen.

Decreases Gene Function: Nighttime pain relievers, antihistamines, anti-seizure medications, sleep aids, antidepressants, incontinence drugs and narcotic pain relievers.

Research: Phosphatidylethanolamine-N methyltransferase (PEMT) catalyzes the synthesis of phosphatidylcholine.

Choline is responsible for shuttling fat out of the liver, aiding the gallbladder, healthy cell membranes to protect against inflammation, lowering anxiety, preventing damage from glutamate spikes, deep sleep, healthy DNA, healthy pregnancy and breast health. Non-Alcoholic Fatty Liver Syndrome occurs mainly from a choline deficiency. Choline deficiency also increases sensitivity to carcinogenic chemicals, mycotoxins and vegetable oils due to poor cell membrane health.

Research shows that the highest dietary intake of choline is found from people in the Northern countries, whereas Mediterranean countries had the lowest intake. Worldwide, total choline intake in adults ranges from 284 mg/day to 468 mg/day for men, from Taiwan and Sweden, respectively; and from 263 mg/day to 374 mg/day for women, from Mexico and Sweden. Major food sources of dietary choline vary by country. For example, eggs, meat, and dairy are the major sources of total dietary choline in New Zealand, while eggs, seafood, meats, and soy products are the predominant sources in Japan and China.

Having one or more T alleles at rs7946 is associated with having lower phosphatidylcholine production in the liver.

More than 40% of women have a genetic polymorphism in PEMT (rs12325817) that makes this gene unresponsive to estrogen, which creates the same high choline requirement as men. These women may be especially sensitive to dietary choline variations during pregnancy. One study found that the highest quintile of choline consumption was associated with a lower risk of breast cancer compared with the lowest quintile.

Eighty percent of the women who were homozygous for the rs12325817 SNP manifested signs of choline depletion (liver or muscle dysfunction), relative to 43% of subjects carrying one copy of the variant allele and 13% of subjects without the SNP. Almost 75% of the North Carolina population in the United States has one variant allele.

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 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	GG		
MTHFR 1298 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			GG
MTHFD1 G1958A (Methylenetetrahydrofolate dehydrogenase 1) encodes a protein that possesses three distinct enzymatic activities in the interconversion of 1-carbon derivatives of tetrahydrofolate.	MTHFD1 G1958A-rs2236225			AA
DHFR A20965G Dihydrofolate reductase (DHFR) catalyzes the reduction of dihydrofolate to tetrahydrofolate (THF) and affect synthetic folic acid metabolism.	DHFR A20965G-rs1643659		CT	
	DHFR C19483A-rs1677693		GT	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
MTR A2756G MTR (methionine synthase) combines folate, methyl B12 and homocysteine into methionine.	MTR A2756G-rs1805087	AA		
MTRR A66G 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	
TCN2 C766G Transcobalamin II (TCN2, or holotranscobalamin when bound) transports B12 to peripheral tissues. Variants in this gene may affect B12 transport.	TCN2 C766G-rs1801198			GG
PEMT Variants in PEMT may increase the need for choline and increase the sensitivity to anticholinergic drugs.	PEMT-rs7946		CT	
	PEMT-rs12325817	CC		
CBS A13637G 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 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-rs234709		CT	
	CBS 191150T-rs4920037		AG	
BHMT	BHMT-rs3733890		AG	

MY CLINICAL RESEARCH SUMMARY: HORMONE SUPPORT

Sex Hormone Binding Globulin

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
SHBG rs1799941	Heterozygous AG
SHBG rs12150660	Heterozygous GT

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	Homozygous GG

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.

Estrogen Metabolism-CYP2C19

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
CYP2C19*17 rs12248560	Heterozygous CT

Recap

Improves CYP2C19 Gene Function: Unknown.

Decreases CYP2C19 Gene Function: Talk with your doctor regarding natural supplements and pharmaceutical drug interactions that may use this shared pathway.

ESTROGEN METABOLISM-CYP2C19

Individuals with the T allele for CYP2C19*17 are considered the ultra-rapid metabolizer phenotype.

Women with CYP2C19*17 T allele were associated with a decreased risk of breast cancer due to the increased metabolism of estrogen, thereby decreasing the level of harmful estrogen metabolites. The CYP2C19*17 T allele decreased the risk of breast cancer in patients using hormone therapy.

Women with CYP2C19*17 T allele were also associated with decreased risk of endometriosis.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
SHBG 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-rs1799941		AG	
	SHBG-rs12150660		GT	
DI01 DI01 is connected to thyroid health and is responsible for the deiodination of T4 into T3.	DI01-rs2235544		AC	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
DI02 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 Vitamin D is technically a hormone, and CYP2R1 is connected to circulating vitamin D levels.	CYP2R1-rs10741657			GG
CYP1A1 CYP1A1 is in the estrogen metabolism pathway along with CYP1B1, CYP1A2, CYP31A, SULT's and COMT.	CYP1A1-rs1048943	TT		
CYP2C19*17 Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens.	CYP2C19*17-rs12248560		CT	
CYP1A2 CYP1A2 is a key enzyme in caffeine metabolism and the 2-hydroxylation of the main estrogens, estrone, and estradiol.	CYP1A2-rs762551		AC	
COMT COMT is involved in catecholamine, dopamine, adrenaline, and estrogen metabolism through the inactivation of the catechol estrogens.	COMT-rs4680	GG		
FUT2 The FUT2 gene controls prebiotic production, B12 absorption, and how much bifidobacteria you carry in your digestive tract.	FUT2-rs601338		AG	
MTNR1B The MTNR1B gene encodes for the melatonin receptor 1B.	MTNR1B-rs10830963	CC		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
CYP27B1	CYP27B1-rs4646536		AG	
VDR-FOK	VDR-FOK-rs2228570			GG
GC	GC-rs2282679	TT		
DHCR7	DHCR7-rs12785878	TT		

MY CLINICAL RESEARCH SUMMARY: MENTAL HEALTH & COGNITIVE PERFORMANCE

MAO-Serotonin

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
MAO-A rs6323	Wild Type TT

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.

You have the TT genotype that encodes for the slow activity of the MAO-A enzyme, which helps preserve serotonin. The TT genotype, constipation, and high estrogen cause a very slow MAO-A enzyme in females, which can increase sensitivity to stress due to high levels of estrogen, serotonin, and poor detoxification. Fiber, B6, B2, and magnesium are crucial for this genotype. The TT genotype may also make you more sensitive to MAO inhibitors, SSRIs, antibiotics and oral contraceptives depending on your estrogen status.

Research has found that the transport of tryptophan (precursor to serotonin) is lower in children with ADHD, and one study found that the rs6323 TT genotype was a protective factor against ADHD in Korean children.

Serotonin levels are more complicated than assessing just MAO-A, including gender, estrogen fluctuations, chronic stress, antibiotic use and general gut health, COMT function, and serotonin transportation and receptor genes. Serotonin is responsible for well-being, happiness, memory, and appetite. When serotonin is too low, it can cause depression, lack of ambition, and a struggle to derive pleasure from life. When it is dysregulated, it can cause IBS, mania, OCD, and drug-induced serotonin syndrome.

To modulate healthy serotonin levels, research has found that aerobic exercise to fatigue, strength training, yoga, and nature walks all are effective. Fermented foods and probiotics (90% of serotonin is made in the gut), getting more sunlight, or taking vitamin D, dark chocolate, fish oil, and a weekly massage are also excellent strategies. However, both extremes of a sedentary lifestyle and excessive exercise negatively affect MAO-A.

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 AG 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 CT

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 (CT 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.

Brain Health-PEMT

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
PEMT rs7946	Heterozygous CT
PEMT rs12325817	Wild Type CC

Recap

Improves PEMT Gene Function: Choline, vitamin C, and estrogen.

Decreases Gene Function: Nighttime pain relievers, antihistamines, sleep aids, antidepressants, incontinence drugs and narcotic pain relievers.

BRAIN HEALTH-PEMT

Research: Choline is required for acetylcholine, a neurotransmitter of the vagus nerve that innervates multiple organs including the lungs, heart, liver, stomach, ovaries, and temporal lobe of the brain. A deficiency could affect all of these, especially memory. Acetylcholine also plays a role in promoting REM sleep.

Having one or more T alleles at rs7946 is associated with having lower phosphatidylcholine production in the liver.

Eighty percent of the women who were homozygous for the rs12325817 SNP manifested signs of choline depletion (liver or muscle dysfunction), relative to 43% of subjects carrying one copy of the variant allele and 13% of subjects without the SNP.

Vitamin C has been shown to induce the release of acetylcholine from synaptic vesicles of neurons and increase acetylcholine levels in the brain.

Possible drugs that can cause memory loss include antidepressants, antihistamines, anti-anxiety medications, anti-seizure drugs, muscle relaxants, tranquilizers, sleeping pills, and pain medications given after surgery. Why? The majority of these are in a class called anticholinergic drugs and block acetylcholine.

A French study looking at 4,128 women and 2,784 men that reported taking anticholinergic drugs showed a greater decline over four years in verbal fluency scores and in global cognitive functioning than women not using anticholinergic drugs. In men, an association was found with a decline in visual memory and to a lesser extent in executive function. Significant interactions were observed in women between anticholinergic use and age, APOE genotype, or hormone replacement therapy. A significantly 1.4–2 fold higher risk of cognitive decline was observed for continuous anticholinergic users.

These drugs could be especially theoretically problematic for those with poor PEMT function, low estrogen (in women) and a family history of dementia and Alzheimer's disease.

Research shows that only 15% of women get enough choline, and one study found that those with lowest choline have the highest anxiety.

Glutamate-BDNF

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
BDNF rs6265	Heterozygous CT

Recap

Improves BDNF Gene Function: Running, DHA, milk thistle, green tea, low glycemic diet, normal levels of glutamate, lithium, acetylcholine, sunlight and heat exposure, bifidobacterium longum, intermittent fasting, turmeric, testosterone and estradiol (women).

Decreases BDNF Gene Function: Chronic stress, high blood sugar and head injuries.

GLUTAMATE-BDNF

Research: BDNF (brain-derived neurotrophic factor) is the most important protein abundantly expressed in brain functions related to repair, spatial learning, episodic memory, and adaptability.

BDNF is a synaptic modulator of glutamate while GABA synapses are also regulated by BDNF. Therefore, BDNF regulates glutamate release and regulates glutamate receptor function. Chronic stress leads to decreased BDNF expression in the hippocampus, leading to enhanced anxiety-related behaviors.

There is building evidence that shows impaired glutamate synapses where compromised BDNF function has been observed such as Alzheimer’s, Parkinson’s, Huntington's disease, depression, bipolar disorder, migraines, and anxiety with the BDNF polymorphism Val66Met. It should be noted that a 2015 meta-analysis did not find a correlation with BDNF val66met and Alzheimer’s disease.

BDNF is present in many regions of the central nervous system, including the hippocampus, cerebral cortex, cerebellum, hypothalamus, substantia nigra, amygdala, and spinal cord. The CT and TT genotypes have lower secretion and blood levels of BDNF and research suggests that upregulating BDNF-activated pathways may be therapeutically relevant.

Evidence suggests that a decrease in hippocampal BDNF may account for the cognitive deficits and the impairment of memory

in depression and anxiety disorders. Another study with depressed patients with BDNF polymorphisms found that the individuals with heterozygous or homozygous genotypes were significantly associated with an increased risk of suicidal behavior.

A 2012 and 2017 study found that episodic memory improves as maximal oxygen capacity increases. Aerobic activity induces a structural change in hippocampal volume and vasculature, responsible for episodic memory. It is the hippocampus that displays dramatic volume changes in disease states such as Alzheimer's disease and depression.

Mice studies have shown that the hormone irisin is generated by the muscles during endurance exercise and is responsible for producing BDNF. Further research has found that running produces a higher level of neurogenesis compared to resistance training and high-intensity training.

Exercise has been shown to cause a rise in serum BDNF and is especially enhanced in the heat. Since permeability of the blood-brain barrier increases with exercise in the heat, the hypothesis was raised that this causes a higher cerebral output of BDNF.

Research also found that BDNF levels are equally decreased in bipolar disorder during the occurrence of manic and depressive episodes. An interesting connection here is that when glutamate plummets, depression occurs. When glutamate spikes, mania occurs. If BDNF is suppressed, glutamate modulation is compromised.

An example of low glutamate can be seen in female patients with depression that have been found to have abnormally high expression levels of many genes that regulate the glutamate system. Recent studies found that a low dose of the drug ketamine, which alters glutamate system activity, can rapidly eliminate depression in two-thirds of patients who do not respond to conventional antidepressants. Conventional antidepressants target the monoamine (MAO) systems, which secrete the neurotransmitters dopamine, serotonin or norepinephrine.

In a 2017 study of 458 soldiers, those with the BDNF Met/Met genotype (homozygous TT), 57.9 percent had a history of one or more prior concussions, compared with 35.6 percent of those with other BDNF genotypes. Those with the BDNF Met/Met genotype also reported greater aggression and hostile personality characteristics. When combined in a predictive model, prior military deployments, being male, and having the BDNF Met/Met genotype were independently associated with an increased lifetime history of concussions in active-duty soldiers.

Low levels of BDNF have been shown in research to cause impaired glucose metabolism, highlighting the blood sugar connection of Type 2 diabetes to dementia and depression in epidemiological studies. Other studies have found high BDNF levels in those who already have Type 2 diabetes, with researchers hypothesizing that BDNF tries to overcompensate to reduce insulin and glucose levels, as has been found when BDNF is injected into diabetic rats.

When reviewing your genetic analysis, it is important to also look at the genes 5-HT2A, PEMT, CYP2R1, APOE, GAD1, SLC17A7, TCF7L2, FADS1, FADS2 and TCN2 to see how BDNF is most affected, and where you need to focus most nutritionally.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
MAO-A 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	TT		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
5-HT2A 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		
5-HT2A 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-rs6311	CC		
	5-HT2A-rs6313	GG		
COMT V158M COMT is connected to dopamine, adrenaline, estrogen and catecholamine metabolism.	COMT V158M-rs4680	GG		
	COMT-rs4633	CC		
ANKK1 ANKK1 modulates the density of dopamine receptors in the brain.	ANKK1-rs1800497		AG	
DAO C2029G DAO participates in the degradation of extracellular histamine. This gene is connected to migraines.	DAO C2029G-rs1049793	CC		
HNMT C314T Histamine N-methyltransferase (HNMT) is a histamine-metabolising enzyme expressed in the brain. This gene is connected to migraines.	HNMT C314T-rs11558538		CT	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
HNMT 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	
FAAH FAAH (fatty acid amide hydrolase) is a gene that encodes for anandamide breakdown, a neurotransmitter and endogenous cannabinoid.	FAAH-rs324420	CC		
PEMT Choline is required for acetylcholine, a neurotransmitter of the vagus nerve that enervates numerous organs.	PEMT-rs7946		CT	
	PEMT-rs12325817	CC		
GAD1 GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA.	GAD1-rs3749034	GG		
BDNF BDNF is a synaptic modulator of glutamate while GABA synapses are also regulated by BDNF.	BDNF-rs6265		CT	
SLC17A7 SLC17A7 mediates the uptake of glutamate into synaptic vesicles at presynaptic nerve terminals of excitatory neural cells in the brain. Polymorphisms are associated with delayed recovery time from head injuries.	SLC17A7-rs74174284		CG	
APOE Apolipoprotein E (APOE) is a lipid binding protein that transports triglycerides and cholesterol in multiple tissues, including the brain.	APOE-rs429358	TT		
	APOE-rs7412			CC

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
GAD1 GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA.	GAD1-rs2241165			TT
	GAD1-rs3791851		CT	
	GAD1-rs3791850	GG		

MY CLINICAL RESEARCH SUMMARY: DETOXIFICATION

Liver Enzyme-CYP1A2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
CYP1A2 C164A rs762551	Heterozygous AC

Recap

Improves CYP1A2 Gene Function: Unfiltered fermented drinks (Kombucha, beer, wine), hops, marinades, cruciferous vegetables, blueberries, blackberries, red grapes, kiwi, watermelon, parsley, and spinach.

Decreases CYP1A2 Gene Function: Heterocyclic amines, nitrosamines, aflatoxin B1, polycyclic aromatic hydrocarbons, dioxins, and β-naphthoflavone. Omeprazole and primaquine are inducers. Caffeine and Tylenol combined with these compounds can make the effect worse.

LIVER ENZYME-CYP1A2

Research: Approximately 200 polymorphisms exist in CYP1A2 gene region, with numerous studies focusing on rs762551. You have the heterozygous (AC) rs762551 genotype, which is the intermediate metabolizer.

The cytochromes P450 liver enzymes play an important role in the development of various cancers since they are involved in the metabolic transformation of numerous endogenous and exogenous compounds including carcinogens. CYP1A2 is a key factor in the metabolic activity of carcinogenic aromatic and heterocyclic amines, and researchers have found that the inhibition activity of this enzyme may represent a logical strategy for preventing the development of human cancers induced by the aromatic and heterocyclic amines. Further research has shown a cumulative value of phase I (CYP-450 enzymes) and phase II enzymes (GSTM1, GSTP1 and NAT2) in determining individual carcinogenic potential of compounds.

Heterocyclic amines (HCAs) are created by high heat reacting with the proteins. The way to reduce HCAs is to use marinades. Marinades reduce HCAs by up to 90 percent. For further protection, pair with cruciferous vegetables (especially fermented like sauerkraut) and an unfiltered beer or Kombucha due to the protection of the yeast. Red wine, blueberries, blackberries, red grapes, kiwi, watermelon, parsley, and spinach all inhibit the mutagenic activity of certain HCAs in vitro.

High antioxidant fruits, lemon juice, herbs, and spices help keep meat fresh and juicy while protecting against HCAs and reducing AGEs.

Grass-fed meat is higher in vitamin E, and in a study adding concentrations of vitamin E to the surface of ground beef reduced HCA production by 70%. Aim for medium to medium-rare for red meat, flip often and avoid burning. The darker the color the higher the HCA concentrations.

Nitrosamines are used in pesticides, created by frying meat, and from a conversion in the gut by nitrites from cured meats. Vitamin C prevents nitrites from becoming nitrosamines. Limit cured meat consumption using nitrites and take vitamin C when needed.

Aflatoxin B1 is the most common in food and amongst the most potent genotoxic and carcinogenic. It can occur in grain-fed milk, nuts/grains stored in hot conditions or bins, vegetable oils, cocoa or coffee beans stored in warm conditions, and dried fruit. We don't recommend Brazil nuts because they are prone to aflatoxin contamination. Choose nuts and seeds in sealed bags, preferably sprouted. You also want to minimize or avoid oats (unless tested free of ochratoxin). Low protein diets may increase the toxicity of aflatoxin and promote cancerous growth.

Hops in beer contain a flavonoid called xanthohumol, which strongly inhibits CYP1A2. Xanthohumol has anti-carcinogenic properties and has been found to scavenge reactive oxygen species, including hydroxyl- and peroxyl radicals, and to inhibit superoxide anion radical and harmful nitric oxide production.

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.

Vitamin K2-VOKRC1*2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
VKORC1*2 rs9923231	Homozygous TT

Recap

Improves VOKRC1*2 Gene Function: Vitamin K2, probiotics and prebiotics.

Decreases Gene Function: Warfarin, statin drugs, antibiotics and vitamin K2 deficiency.

VITAMIN K2-VOKRC1*2

Research: Vitamin K2 is produced by intestinal microbiota and is usually enough to cover the daily requirements. It is fat soluble and stored in the liver. If your gut flora is disturbed by FUT2 genes, elevated glutamate, gluten sensitivity, and you have used the drug Warfarin or antibiotics, your K2 requirements may be higher.

Vitamin K2 deficiency is linked to arterial calcification, osteoporosis and poor dental health. This is why long-term use of anticoagulants like Warfarin are linked to accelerated bone loss and bone mass. Recent research has shown that vitamin K2 plays a role in having an inhibitory effect on breast cancer cells.

Polymorphisms in VOKRC1 have been linked to higher rates of arterial calcification and may increase the need for vitamin K2. To paraphrase one study, "A lifelong decreased activity of the VKORC1 enzyme may increase the risk of vascular calcification and could be further worsened by reduced intake of vitamin K2."

Polymorphisms in VOKRC1*2 may increase the sensitivity to Warfarin dosing and vitamin K recycling. VKORC1*2 appears to be the most important in relation to the variability in response to oral anticoagulants and the risk of excessive bleeding. Vitamin K2 has also been found in studies to be inhibited by statin drugs.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
CYP1A1*2C 4889 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 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 The CYP1B1 gene metabolizes pro-carcinogens such as polycyclic aromatic hydrocarbons and 17 beta-estradiol.	CYP1B1*6 L432V-rs1056836	GG		
CYP2C9*3 A1075C Variants in CYP2C9 rs1057910 may alter the metabolism of THC, the psychoactive compound found in cannabis.	CYP2C9*3 A1075C-rs1057910	AA		
CYP2D6 T100C CYP2D6 metabolizes approximately 50% of drugs in clinical use.	CYP2D6 T100C-rs1065852	GG		
CYP2E1 Research has identified CYP2E1 as the primary P450 isozyme responsible for benzene metabolism at low concentrations, acrylamide to glycidamide, alcohol, Tylenol, and nitrosamines.	CYP2E1-rs2031920	CC		
CYP3A4*1B 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 Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens.	CYP2C19*17-rs12248560		CT	
VKORC1*2 Variants in VOKRC1*2 may increase the need for vitamin K2 and a sensitivity to dosing of the drug Warfarin.	VKORC1*2-rs9923231			TT

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
NAT2 The NAT2 gene encodes an enzyme that functions to activate and deactivate arylamine, hydrazine drugs, and carcinogens.	NAT2-rs1495741		AG	
COQ2 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	TT		
CYP17A2	CYP17A2-rs743572		AG	

MY CLINICAL RESEARCH SUMMARY: IMMUNE SUPPORT, ANTIOXIDANTS AND INFLAMMATION

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-GSTM1

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
GSTM1 rs366631	Wild Type AA

Recap

Improves GSTM1 Gene Function: Cruciferous vegetables, vitamin C, vitamin A, vitamin E, milk thistle, resveratrol, curcumin, green tea and white tea.

Decreases GSTM1 Gene Function: Low intake of vitamin A, C, E and cruciferous vegetables, smoking, burning of wood or trash, asphalt, coal, diesel exhaust, gas cooking, dioxins, and grilled or charred meat.

GLUTATHIONE-GSTM1

Research: GSTM1 rs366631 is a pseudo-SNP that can be used as a GSTM1 deletion marker. The deletion is also known as the null genotype and confers the absence of the GSTM1 protein. The frequency of the null genotype varies from 20% to 80%, depending on the ethnic group studied.

For example, the null genotype is less frequent in western and southern African populations, less frequent in South American populations, intermediate in the Japanese, but is higher in Egyptian, European, American, and Asian populations.

High frequencies of the GSTM1 null genotype have been found in patients with lung cancer (East Asians), breast cancer (over 50 age group and in Asians), bladder cancer (with NAT2 slow acetylator), colorectal cancer, skin cancer, gastric cancer (among Asians with H. Pylori), chronic bronchitis, kidney disease progression, acute myeloid leukemia, acute lymphoblastic leukaemia, head and neck cancer (combined with CYP1A1 variant), endometriosis, type 2 diabetes retinopathy, and recurrent pregnancy loss. All have been regarded as environmentally induced and the risk may change with ethnicity.

Of the major glutathione enzymes, GSTM1 appears to be the most effective at neutralizing cytotoxic and genotoxic reactive compounds. However, the research shows that the null genotype of GSTM1 on its own may not be able to determine carcinogen exposure cancer risk. Instead, a combination of genotypes in the other glutathione and antioxidant genes like GSTP1 and NFE2L2, detoxification genes like CYP1A1 and NAT2, and/or compounding epigenetic habits that appear to modify the effect.

GSTM1 catalyzes the detoxification of alkyl and polycyclic aromatic hydrocarbons, intermediate forms of many carcinogens, specifically metabolically generated epoxide intermediates of benzo(a)pyrene. Benzo(a)pyrene is part of a class of chemicals called polycyclic aromatic hydrocarbons. Sources of benzo(a)pyrene include the burning of wood or trash, tobacco smoke, asphalt, coal, diesel exhaust, and grilled or charred meat. There is evidence that it causes skin, lung, and bladder cancer in humans and in animals. Research has also shown that early markers of cardiovascular disease are associated with occupational exposure to polycyclic aromatic hydrocarbons.

A study also found sensitivity to gas cooking and the GSTM1 null genotype, increasing the sensitivity of the lungs to nitrogen dioxide. Nitrogen dioxide is also found in diesel exhaust. Exposure of human blood plasma to nitrogen dioxide caused rapid losses of ascorbic acid, uric acid, protein thiol groups, lipid peroxidation, and depletions of alpha-tocopherol, bilirubin, and ubiquinol leading to high levels of oxidative stress.

Animal studies and in vitro studies have shown that vitamin C, vitamin E, vitamin A, resveratrol, curcumin, green tea, and white tea can inhibit the carcinogenic effect of benzo(a)pyrene and nitrogen dioxide. In the Norwegian Mother and Child Cohort Study 50,651 women, a higher prenatal exposure to dietary benzo(a)pyrene was found to reduce birth weight. However, increasing dietary vitamin C intake during pregnancy helped reduce any adverse effects of benzo(a)pyrene on birth weight.

Isothiocyanates from cruciferous vegetables are known for their anti-cancer activity. They are stored as glucosinolates in cruciferous vegetables and are hydrolyzed by myrosinase (an enzyme found in plants and intestinal microflora) to form isothiocyanates. Isothiocyanates from cruciferous vegetables are substrates and inducers of GSTM1.

GSTM1 variants may alter isothiocyanates clearance, with the null genotype retaining higher levels of isothiocyanates and therefore the benefits. In numerous studies, the GSTM1 null genotype was the most responsive to cruciferous vegetables for anti-cancer effects against lung cancer, colon cancer, breast cancer, and kidney disease.

The isothiocyanate levels in cruciferous vegetables will range based on growing conditions including sulfur and nitrogen levels, time after harvest and storage (cold transportation and storage of broccoli also cause a loss of glucosinolates up to 70-80%), plant genetics, and cooking preparation. Broccoli sprouts will yield the highest isothiocyanate levels.

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 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%.

Eye Health-CFH

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
CFH rs1061170	Heterozygous CT

Recap

Improves CFH Gene Function: Lutein, zeaxanthin, bilberry, lingonberry, vitamin C, vitamin E, DHA, and zinc.

Decreases CFH Gene Function: Smoking, pesticides, benzene (found in certain laundry detergents, gasoline and paint), aspartame, oxidative stress, elevated TNF-alpha, elevated IL-6, obesity, smoking, diabetes, hypertension, atherosclerosis and low intake of lutein and zeaxanthin.

EYE HEALTH-CFH

Research: Age related macular degeneration (AMD) is the leading cause of blindness in Western societies, but its etiology remains largely unknown.

Variants in CFH confers a 2-fold higher risk of late AMD per copy in individuals of European descent. Research indicates that CFH (rs1061170) polymorphism impacts significantly on retinal function in early AMD patients, and supports the hypothesis that a dysfunctional CFH might result in early retinal function loss due to a reduction in the immune antioxidant defense mechanism. A study from 2005 found that variants in CFH likely explains approximately 43% of AMD in older adults.

Malondialdehyde (MDA) is a common lipid peroxidation product that accumulates in many pathophysiological processes, including AMD. In vivo studies in mice found CFH as a major MDA-binding protein that blocks MDA-modified proteins by macrophages and MDA-induced pro-inflammatory effects. The CFH polymorphism markedly reduces the ability of CFH to bind MDA, indicating a causal link to a cause of age related macular degeneration.

A recent meta-analysis found that the rates of myopia (nearsightedness) will increase 140% by 2050 due to our increased time in front of a screen. Myopia can increase the risk of numerous eye disorders. 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. Research has found that bilberry and lingonberry exert protective effects against blue LED light-induced retinal photoreceptor cell damage due to their polyphenol content.

Lutein and zeaxanthin can inhibit oxidation of cell membranes and may be protective against UV-induced eye damage. Studies have demonstrated that people in the highest quintile of intake of dietary carotenoids, especially lutein and zeaxanthin concentrations have significantly lower risk of macular degeneration. Blue-eyed adults have far less lutein and zeaxanthin in their retinas.

One study compared diets of 356 patients with macular degeneration with 520 patients with other eye diseases. The data revealed that beta carotene was not especially effective, but that lutein and zeaxanthin were. Another study found that the risk of macular degeneration was reduced 65 percent with high amounts of lutein and zeaxanthin.

Research has found that MDA levels are significantly increased in groups of subjects with deficient levels of vitamin C and vitamin E. Deficiency in these two antioxidants leads to insufficient defense against free radicals and increased MDA levels. Those with polymorphisms in CTH should increase vitamin C and vitamin E intake. In another study, the risk for macular degeneration was found to be 77% lower when vitamin C supplements and a low-glycemic diet was used.

One study followed 3,600 people ages 55-80 years old for six years and found that those that took antioxidants plus zinc were less likely than those who took only antioxidants or only zinc to lose their vision.

Studies show that people who consume more fish, which is rich in DHA-fish fat, are less likely to develop macular degeneration. Eating fish one to three times a week has been associated with a 40 to 75 percent reduction in macular degeneration.

Eye Health-ARMS2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
ARMS2 rs10490924	Heterozygous GT

Recap

Improves ARMS2 Gene Function: Lutein, zeaxanthin, bilberry, lingonberry, vitamin C, vitamin E, DHA, and zinc.

Decreases ARMS2 Gene Function: Smoking, pesticides, benzene (found in certain laundry detergents, gasoline and paint), aspartame, oxidative stress, elevated TNF-alpha, elevated IL-6, obesity, smoking, diabetes, hypertension, atherosclerosis and low intake of lutein and zeaxanthin.

EYE HEALTH-ARMS2

Research: ARMS2 is considered a second major AMD susceptibility gene next to CFH. CFH and ARMS2 share a common pathway in the pathogenesis of AMD, with ARMS2 polymorphisms disrupting mitochondrial function in the retina.

Research estimates that the risk of AMD can be attributed to 20% from smoking, 36% for variants in ARMS2, and 43% for variants in the CFH gene.

The overall effect of ARMS2 polymorphisms is driven primarily by a strong association in smokers. This gene-environment interaction is supported by statistically independent family-based and case-control analysis methods. Studies have shown that a genetic susceptibility coupled with a modifiable lifestyle factor such as cigarette smoking confers a significantly higher risk of AMD than either factor alone.

Polymorphisms in ARMS2 is also associated with polypoidal choroidal vasculopathy (PCV) and clinical severity in the subgroups of PCV in the Japanese population.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
SOD2 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	
SOD3 Superoxide dismutase (SOD3) is zinc/copper dependent and protects against superoxide for the cell membrane. Variants here increase the need for intracellular and extracellular antioxidant protection.	SOD3-rs1799895	CC		
CAT C-262T CAT makes an enzyme called catalase, which helps reduce oxidative stress.	CAT C-262T-rs1001179	CC		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
GSTM1 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	AA		
GSTP1 I105V 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 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		
GPX1 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	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
CTH 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		GT	
NOS1 NOS1 (nNOS) codes for brain neural transmission, memory, learning, psychological stress, the peripheral nervous system and potentially the lymph nodes.	NOS1-rs3782218	CC		
NOS2 NOS2 (iNOS) encodes for wound, tissue damage, infection and hypoxia (low oxygen).	NOS2-rs2248814		AG	
CFH CFH (complement factor H) polymorphism is associated with increased risk of age related macular degeneration.	CFH-rs1061170		CT	
ARMS2 ARMS2 polymorphism is associated with increased risk of age related macular degeneration (AMD).	ARMS2-rs10490924		GT	
LZTFL1 The LZTFL1 gene influences the transition of specialized lung cells to less specialized lung cells during infection and inflammation.	LZTFL1-rs17713054	GG		
IL-10	IL-10-rs1800871	GG		
NQ01	NQ01-rs1800566		AG	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
IL-10	IL-10-rs1800872	GG		
IL-10	IL-10-rs1800896		CT	

MY CLINICAL RESEARCH SUMMARY: DNA PROTECTION, DAMAGE & REPAIR

DNA Repair-MDM2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
MDM2 rs2279744	Homozygous GG

Recap

Improves MDM2 Gene Function: Vitamin C, niacin, zinc, vitamin D and selenium.

Decreases MDM2 Gene Function: Excessive sun exposure in females.

DNA REPAIR-MDM2

Research: Unlike Tp53, the research found that MDM2 variants did not correlate with latitude and temperature. However, the variants did correlate with UV radiation.

The researchers theorized that as people moved out of Africa and into Asia, the lower levels of DNA-damaging UV light meant they could afford to have less p53 in their cells, which is better for pregnancy. However, females (but not males) with the GG genotype and lower p53 may have less DNA damage protection.

If melanoma runs in your family, you are female and Tp53 is homozygous, you may need to be more prudent about avoiding excessive sun exposure and increasing vitamin C and niacin.

Dandelion root extract has been found to induce apoptosis (cell death) in human melanoma cancer cells that were chemo-resistant. Ashwagandha root extract is another herb that has been found to induce apoptosis in melanoma cells.

A study from 2015 found that vitamin C could re-program melanoma cells and potentially be an epigenetic treatment for melanoma. Another study found that vitamin D3 and the VDR receptor have a role in the regulation of MDM2 gene expression.

Processed Meat and Colon Cancer-GATA3

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
GATA3 rs4143094	Heterozygous GT

Recap

Improves GATA3 Gene Function: Avoiding processed meats.

Decreases GATA3 Gene Function: Processed meats like hot dogs, cured meats, pepperoni and sausages.

PROCESSED MEAT AND COLON CANCER-GATA3

Research: A large-scale genome-wide analysis of over 18,000 people from the U.S., Canada, Australia and Europe found that variants in GATA3 (rs4143094) was associated with an increased risk of colon cancer for those eating processed meat compared to those with the normal genotype.

A meta-analysis revealed that by raising the serum level of vitamin D to 34 ng/ml, the incidence rates of colorectal cancer could be reduced by half. Researchers projected a two-thirds reduction in incidence with serum levels of 46 ng/ml, which corresponds to a daily intake of 2,000 IU of vitamin D3.

All of the foods below have been found in research studies to reduce the risk of colon cancer: black raspberries, blackberries, raspberries, cranberries, blueberries, apples, oranges, avocado, tomatoes, garlic, onions, shallots, leeks, cabbage, sauerkraut, broccoli, Brussels sprouts, sweet potatoes, beets, spinach, kale, asparagus, cauliflower, turmeric, rosemary, oregano, basil, thyme and parsley. Preventing constipation should be a priority.

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 ATM coordinates DNA repair by activating enzymes that fix double stranded DNA breaks.	ATM D1853N-rs1801516	GG		
ESR2 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	AA		
TP53 TP53 is a tumor suppressor gene responsible for DNA repair.	TP53-rs1042522		CG	
MDM2 Variants in the MDM2 gene encode a protein that reduces cellular levels of the p53 tumor suppressor protein.	MDM2-rs2279744			GG
MLH1 MLH1 codes for a DNA repair enzyme linked to colon health.	MLH1-rs1800734		AG	
GATA3 GATA3 factors are involved in cellular maturation with proliferation arrest and cell survival.	GATA3-rs4143094		GT	
SIRT1 SIRT1 senses changes in intracellular NAD+ levels and plays a role in DNA damage and repair.	SIRT1-rs7895833	AA		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
XRCC3 XRCC3 participates in DNA double-strand break/recombination repair.	XRCC3-rs861539		AG	

MY CLINICAL RESEARCH SUMMARY: CARDIOVASCULAR HEALTH AND ATHLETIC PERFORMANCE

Power and Recovery-ACTN3

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
ACTN3 rs1815739	Heterozygous CT

Recap

Improves ACTN3 Gene Function: Not applicable for ACTN3.

Decreases ACTN3 Gene Function: Not applicable for ACTN3.

POWER AND RECOVERY-ACTN3

The T (R) allele is associated with enhanced strength and training adaptation, improved protection from eccentric training-induced muscle damage, lower risk of sports injury, and reduced frailty in the elderly. Testosterone levels were also higher in male and female athletes with at least one R allele compared to the XX genotypes. When stratified by race and gender for power athletes in a 2019 meta-analysis, Asian and male athletes benefited the most from the RX (TC) genotype.

The ACTN3 RR and ACTN3 RX groups have not been significantly different, indicating that the presence of one or two R alleles does not have a dose-dependent effect on 200-meter sprint speed in elite athletes. However, 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.

Having the RX genotype may represent the best of both worlds for cold adaptation, longevity, strength training, and exercise recovery.

Lung Cytokines-TNFA

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
TNFA rs1800629	Heterozygous AG

Recap

Improves TNFA Gene Function: Optimal testosterone levels (men), cold showers and ice baths, deep breathing methods, cordyceps, vitamin C, turmeric, boron, ginger, dandelion, purple sweet potatoes, cranberries, blueberries, beet root juice and cherry juice.

Decreases Gene Function: Depression, bacterial overgrowth, overtraining, auto-immune disorders and high blood sugar.

LUNG CYTOKINES-TNFA

Research: Tumor necrosis factor (TNF-) is a pro-inflammatory cytokine. Proinflammatory cytokines, such as TNF-a, are found in airways and are known to induce inflammatory responses and regulate immunity.

The A allele of this polymorphism can lead to high binding affinity of nuclear factors to the TNF promoter, resulting in a high level of transcription activity and secretion levels of TNF-a.

A meta-analysis found that those with the A allele (AG or AA) had 46% increased asthma risk compared to those individuals with the GG carriers. In a stratified analysis by ethnicity, significant associations were shown in Asians, but not Caucasians. The strongest association was found in West Asians and South Asians, but not in East Asians.

Shortened leukocyte telomeres may be linked with elevated concentrations of both interleukin (IL)-6 and TNF-a. In addition, individuals with elevated concentrations of both IL-6 and TNF-□ were more likely to have shortened leukocyte telomeres than those with high concentrations of only one of these molecules. Shorter telomere length is associated with premature aging.

Researchers have shown that high plasma levels of TNF-a are associated with reduced physical performance. The minor A allele rs1800629 SNP was associated with increased plasma TNF concentration and with an impaired improvement of physical performance in older women following physical activity.

Chronically elevated TNF-a has a widespread inflammatory action throughout the body and is elevated in many disorders, including osteoarthritis for the AA genotype in Asian populations. Norepinephrine inhibits the inflammatory pathway by decreasing TNF-□. Studies have found that deep breathing exercises and cold therapy like swimming in cold water and ice baths increase norepinephrine.

Variants in TNF-a may increase the need for anti-inflammatory support including cold water immersion, breathing exercises, cordyceps, vitamin C, turmeric, and ginger, which have all been found to lower TNF-a levels.

Pesticides, HDL and LDL-PON1

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
PON1 rs662	Heterozygous CT

Recap

Improves PON1 Gene Function: Organic foods, calcium, magnesium, boron, lycopene, alpha-lipoic acid, gamma-linolenic acid (black cumin seed oil), broccoli sprouts, vitamins E, B1, B2, B5, B6, selenium, omega 3 fatty acids, high quality olive oil, polyphenols, naringenin, quercetin, pomegranates and alcohol in moderate amounts (1 drink for women and 1-2 drinks for men).

Decreases PON1 Gene Function: Pesticides, proton pump inhibitors, mercury, calcium deficiency and high homocysteine.

PESTICIDES, HDL AND LDL-PON1

Research: Paraoxonases (PON1) are a family of enzymes involved in breaking down chemicals including several types of pesticides and pharmaceutical drugs. They are involved in protecting both high and low-density lipoproteins from oxidation, an important mechanism in atherosclerosis and heart disease. The rs662 SNP is the most clinically relevant for PON1. The C allele is also known as the “R” allele in research studies and is connected to atherosclerosis and heart disease.

A 2018 meta-analysis found that carriers of the variant R allele had higher levels of oxidized LDL, triglycerides, total cholesterol, and low-density lipoprotein cholesterol than the non-carriers. This was most pronounced in Asians and coronary heart disease patients. The hypothesis is that decreased levels of PON1 activity may lead to increased circulating levels of oxidized LDL and reduce the capacity of PON1-mediated inhibition of LDL-C oxidation.

Mercury appears to decrease PON1 function and liver expression of the PON1 gene is down-regulated in mice with high homocysteine. The proatherogenic effects of homocysteine may involve decreased serum PON1 activity, leading to impaired antioxidant function and decreased capacity to degrade homocysteine thiolactone.

The availability and catalytic activity of PON1 are impaired in many children with Autism Spectrum Disorders, making them more susceptible to the toxic effects of pesticide residues which are most frequently found on grain.

The rs662 SNP is the most clinically relevant for PON1. You need to make sure you are focusing on foods and drinks that

improve gene function.

All of the vitamins, minerals, and compounds in the "Improves PON1 Gene Function" section have been verified in research to improve PON1 function. One way that pomegranates protect cardiovascular health is by augmenting nitric oxide. In one study, pomegranates protected against atherosclerosis by reducing LDL's basal oxidative status by 90%.

Moderate drinkers can also rejoice. Research has found that alcohol in small amounts (1 drink for women, 1-2 for men based on weight), improved PON1 activity by 395%. However, too much alcohol decreased PON1 by 45%.

A recent study found that red wine induced significant increases in plasma total antioxidant status and significant decreases in plasma MDA (inflammation biomarker). The results show that the consumption of 400 mL/day (14 ounces) of red wine for two weeks, significantly increases antioxidant status and decreases oxidative stress in the circulation.

Non-organic wine in particular may have concentrated amounts of additives, pesticides, insecticides and fungicides, while beer that uses GMO crops may be high in glyphosate (RoundUp). Residual concentrations of many different pesticides that have been detected in bottled wine were similar to initial concentrations on the grapes. The US and France are heavier users of pesticides. Italy and Argentina have been found to have wine most likely free from pesticides and heavy metals.

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.

Fibrinogen-ESR2

Below is a summary of your most significant variant genotypes:

GENE	GENOTYPE
ESR2 rs4986938	Homozygous TT

Recap

Improves ESR2 Gene Function: Nattokinase and lactobacillus plantarum.

Decrease ESR2 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).

FIBRINOGEN-ESR2

Research: ERS2 (rs4986938) is a gene that has implications for normal, heterozygous and homozygous variants depending on the health issue. In the case of fibrinogen levels and post-menopausal women, it is the homozygous TT genotype that is relevant. Fibrinogen is a soluble protein in the plasma that is broken down to fibrin by the enzyme thrombin to form clots. Fibrinogen serves to stop excessive bleeding, but in high amounts can cause blot clots.

Recent observations indicate the involvement of estrogen receptor beta in the pathogenesis of cardiovascular disease in regards to fibrinogen levels. The relative risk showed a significant elevation of plasma fibrinogen in TT compared with CC and CT genotype.

A human study showed that oral administration of nattokinase decreased plasma levels of fibrinogen, factor VII, and factor VIII. After 2 months of administration, fibrinogen, factor VII, and factor VIII decreased 9%, 14%, and 17%, respectively. Further research has found that the probiotic strain lactobacillus plantarum has been found to significantly lower fibrinogen and LDL. Rat studies have also found that long-term administration of Lactobacillus plantarum is effective against breast cancer.

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
ACTN3 ACTN3 encodes for the alpha-actin-3 protein found exclusively within type-II fast-twitch muscle fibers.	ACTN3-rs1815739		CT	
PPARGC1A It has been demonstrated that variants in the PPARGC1A gene affect the exercise-induced change in maximal oxygen uptake (VO2).	PPARGC1A-rs8192678	CC		
TNFA Tumor necrosis factor (TNF-a) is a pro-inflammatory cytokine. Variants may increase the risk of asthma in Asian populations.	TNFA-rs1800629		AG	
IL6 IL6 is an interleukin that acts as both a pro-inflammatory cytokine and an anti-inflammatory myokine.	IL6-rs1800795			GG

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
SOD2 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 COL1A1 produces alpha 1 chain of type I collagen, a major protein in tendons and ligaments.	COL1A1-rs1800012			AA
PON1 PON1 (Paraoxonase) plays a large role in removing pesticides. It is also involved with supporting HDL function and LDL oxidation.	PON1-rs662		CT	
LPA 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 Variants in CYP1A2 determine caffeine metabolism and effects on bone density and cardiovascular health.	CYP1A2 C164A-rs762551		AC	
9p21 9p21 is considered an important genetic marker for cardiovascular health.	9p21-rs4977574			GG
FADS1 FADS1 is involved in fatty acid metabolism, and variants in this gene are associated with elevated triglyceride levels.	FADS1-rs174546	CC		

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
ESR2 ESR2 codes for estrogen receptor beta (ER-β), one of two main types of estrogen receptor activated by estrogen and is linked to fibrinogen levels in post-menopausal women.	ESR2-rs4986938			TT
F5 Variants in F5 increase the risk of deep vein thrombosis, especially if using oral contraceptives.	F5-rs6025	CC		
ADRB2 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 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 Variants in ADD1 are associated with hypertension in Asians.	ADD1-rs4961	GG		
AGTR1 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	

Gene & Gene Function	Gene Rsid	Wild Type	Heterozygous	Homozygous
ACE2 A8790G 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	AA		
TMPRSS2 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		AG	