# Welcome to the future of health and human potential

NAME: TEST ACCOUNT

DATE: SEP 26, 2022

# 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.

Gene By Gene, a wholly owned subsidiary of myDNA, Inc., is a College of American Pathologists (CAP) accredited and Clinical Laboratory Improvement Amendments (CLIA) certified clinical laboratory qualified to perform high-complexity testing. This test was developed and its performance characteristics determined by Gene by Gene. It has not been cleared or approved by the FDA. FDA does not require this test to go through premarket FDA review. This 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.

# TABLE OF CONTENTS

## My Health Report



## My Clinical Research Summary


# NUTRIENT METABOLISM &

# DIGESTION

## APOE Status: E3/E4

**You are a Hunter-Gatherer**

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.

- About 25% of people carry one copy of ApoE4, and 2 to 3% carry two copies
- ApoE4 includes trade-off strengths and weaknesses from the hunter-gatherer period and continues to persist in the modern era
- The strengths include higher fertility rates in women and improved newborn health status, improved protection against bacterial infections, improved cognition and intelligence in early life, and better utilization of fatty acids for endurance exercise
- The weaknesses include a lower response to plant bioactive compounds, higher sensitivity to low vitamin D status, binding of zinc to amyloid plaques, increased plasma cholesterol, lower antioxidant protection, and reduced ability to repair synapses and protect neurons, especially from environmental pollution and head injuries
- The e4/e4 genotype has the strongest risk factor gene for Alzheimer's disease, although inheriting a single or double ApoE4 genotype does not mean a person will develop the disease
- The latest research has shown that the rare e2/e4 genotype is equivalent to e3/e4 in regards to Alzheimer's pathology risk
- The highest negative impact are those with Caucasian and Asian ancestry from the northern hemisphere
- In Alzheimer's patients, the need for DHA, choline, and uridine are all enhanced because their basal plasma levels may be subnormal, and a higher dosage is needed for correcting the disease-related deficiencies in the synaptic membranes and synapses
- Researchers were able to prove that a formulation with DHA, choline, uridine, B-vitamins, vitamin C, and vitamin E improved memory scores and the connectivities between brain regions among patients with early Alzheimer's Disease
- Several compounds isolated from medicinal mushrooms have been shown to promote neurite outgrowth, including those from Lion's mane mushroom, reishi, tiger milk mushroom, Ganoderma neo-japonicum, and Cordyceps militaris
- A hunter-gatherer diet focused on protein, choline, omega-3's, uridine, creatine, berries, fiber, nuts, seeds, antioxidants, lower in carbohydrates, high in potassium, and avoiding alcohol currently appears to be the best strategy for e4 carriers with northern heritage
- Cardio exercise for 30 minutes a day, 5 days a week has been found to dramatically reduce the risk of e4 and Alzheimer's disease and improve lipid markers

## Protein Requirements

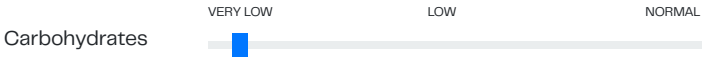
AVERAGE INCREASED HIGH

Protein

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

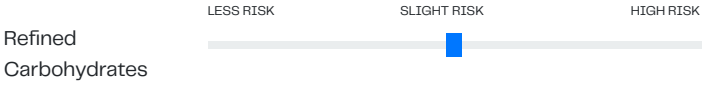
## Carbohydrate Requirements




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 a lower recommended carbohydrate intake, ranging from 20% to 30% of total calories from carbohydrates
- For a 2,000 calorie diet, this comes to 100–150 grams of carbohydrates per day

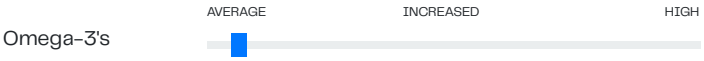
## Carbohydrate Requirements




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

- Your genotype will benefit from limiting refined carbohydrates and choosing fiber-rich carbohydrate sources
- Refined carbohydrate sources include cookies, crackers, chips, tortillas, white bread, refined sugar, and high-sugar juices
- Choosing low glycemic foods is recommended

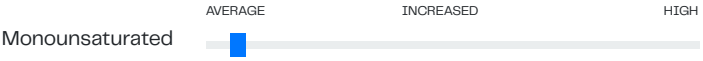
## Fat Requirements




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

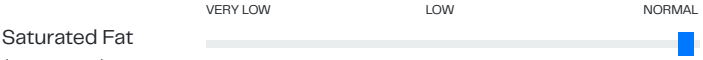
## Fat Requirements




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

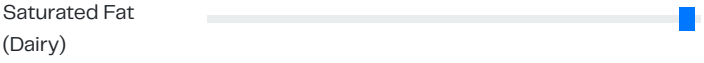
## Fat Requirements




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.

- Your genotype combinations are associated with improved metabolism of saturated fat from red meat

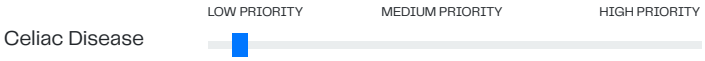
## Fat Requirements




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 low genetic risk for celiac disease
- 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

## Micronutrient Requirements

B1 (Thiamine)


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

- Your genotype is associated with an average need for B1

## Micronutrient Requirements

B2 (Riboflavin)


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

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

## Micronutrient Requirements

B3 (Niacin)


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

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

## Micronutrient Requirements

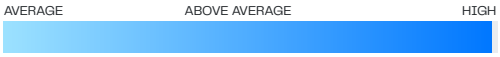
B6 (Pyridoxine)


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

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

## Micronutrient Requirements

B12 (Cobalamin)


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

- Your genotype is associated with an average requirement for B12

## Micronutrient Requirements

Boron


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

- Your genotype is associated with an average need for boron

## Micronutrient Requirements

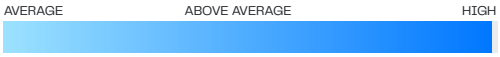
Choline & Betaine


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

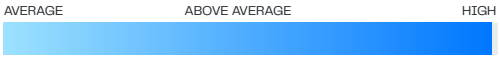



The recommended daily allowance (RDA) for vitamin A is 900 mcg for men and 700 mcg per day for women. Vitamin A assists digestive lining repair, oral health, eye health, iron mobilization, mitochondria health, skin health, healthy lung function, and increased immunity.

- Your genotype is associated with a 69% 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 a higher than average need for magnesium
- Magnesium is depleted by smoking, sugar, chronic stress, high alcohol intake, coffee, tea, fluoridated water, phosphoric acid, non-fermented grains, intense exercise, high protein diets, high calcium supplementation, high arsenic levels, antacids, proton pump inhibitors, ACE inhibitors, birth control, hormone replacement therapy, Estradiol, Premarin, antibiotics, antivirals, immunosuppressants, methylphenidate, Tamoxifen and corticosteroids
- Magnesium is highest in sprouted pumpkin seeds (2 tablespoons, 156mg), hemp seeds (2 tablespoons, 116mg) chia seeds (2 tablespoons, 111mg), Gerolsteiner mineral water (1 liter, 100mg), spinach (1/2 cup cooked, 78mg), wild salmon (6oz., 52mg), and peanut butter (2 tablespoons, 49mg)

## 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 an average need for lithium

## Micronutrient Requirements

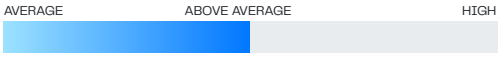
Potassium


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 an average need for selenium

## Micronutrient Requirements

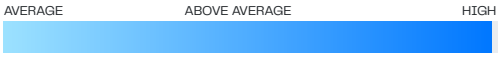
Zinc


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., 629mg), sunflower seeds (1/4 cup, 615mg) and dark chocolate (1 oz., 615mcg)

## Fiber Requirements

Prebiotic Fiber


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 a slighter higher than 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 average requirements for lutein and zeaxanthin to support eye health

## 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 slower metabolism of certain polyphenols, which means you have a higher benefit with a lower intake of green tea, coffee, berries, and chocolate

## Phytonutrient Requirements

Cinnamon


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

- Your genotype is associated with a higher need for cinnamon to control blood sugar and satiety

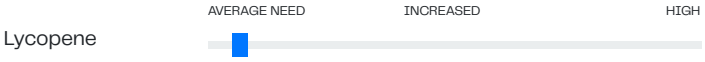
## Phytonutrient Requirements

Cruciferous Vegetables


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

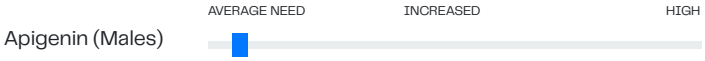
## Phytonutrient Requirements




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

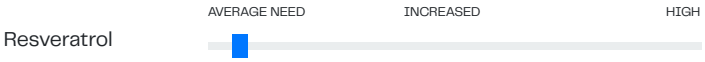
## Phytonutrient Requirements




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

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

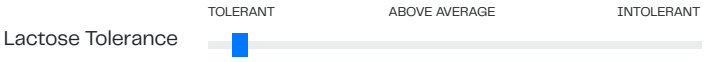
## Phytonutrient Requirements




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

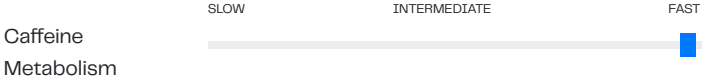
## Lactose Tolerance




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

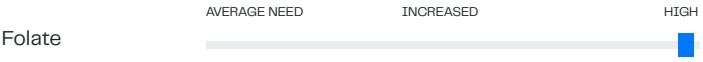



Variants in the CYP1A2 gene determine the rate at which you metabolize caffeine.

- You are a fast metabolizer of caffeine, meaning that you feel the effects of caffeine more quickly, but the effects also wear off quickly


# METHYLATION

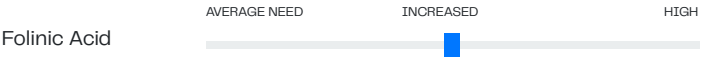
## Methylation




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

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

## Methylation




Folinic acid 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 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

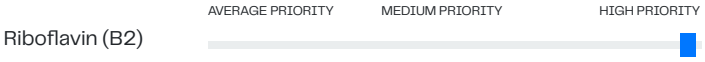
## Methylation




Vitamin B12 plays an important role in homocysteine metabolism.

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

## Methylation




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

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

## Methylation


Choline and betaine 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

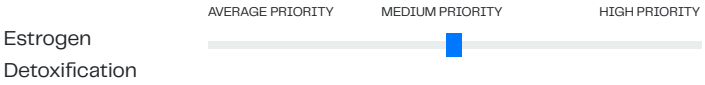
## Methylation


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

- Your genotype combinations may decrease the metabolism of synthetic folic acid, which can increase circulating levels and affect overall folate metabolism
- When possible, avoid foods and drinks fortified with folic acid, and supplements that use folic acid
- Supplements that use methylfolate or folinic acid are better options


# HORMONE SUPPORT

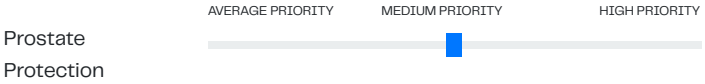
## Hormone Support




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

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

## Hormone Support




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

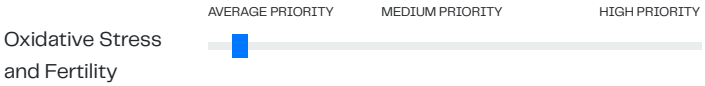
- Your genotype combination is associated with reduced prostate protection
- Improve prostate protection with selenium, vitamin C, B1, B6, folate, zinc, magnesium, healthy iron levels, milk thistle, holy basil, and cruciferous vegetables

## Hormone Support


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

- Your genotype combination is associated with average baseline testosterone levels
- Testosterone promotes lean body mass, decreases recovery time and gives a psychological edge of confidence, concentration, cognitive function and determination
- Low testosterone leads to obesity, loss of muscle, weak bones, and depression, but also increases the odds of heart disease, diabetes, Alzheimer's and other major health problems
- Testosterone peaks throughout puberty and continues to stay in optimal ranges until around 40 years old
- Magnesium, zinc, vitamin D, omega-3's, boron, fat intake, compound weight lifting, sprints, chopping wood and eight hours of sleep per night have all been found to increase testosterone
- The optimal level appears to in the 550-900 ng/dl range to reduce risk according to the American College of Cardiology

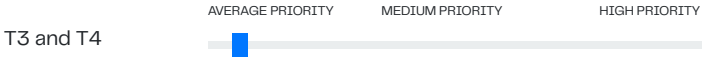
## Hormone Support




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

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

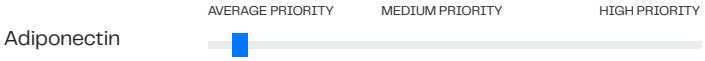
## Hormone Support




T3 and T4 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

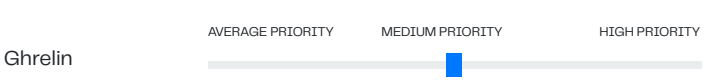
## Hormone Support




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




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

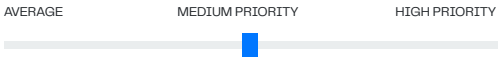
Brain Repair and Maintenance


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

## Mental Health and Cognitive Performance

Episodic Memory

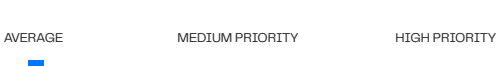



The 5-HT2A gene is associated with episodic memory, which is the ability to recall details of an event.

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

## Mental Health and Cognitive Performance

Cardio, Mood and Cognitive Fitness




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

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

## Mental Health and Cognitive Performance

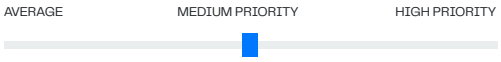
Mood (Folate)


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

- Your genotype may require 400-600mcg (or more) for healthy BH4 levels responsible for neurotransmitter balance
- Foods high in folate include:
- Liver (215mg) 3 oz.
- Spinach (131mg) 1/2 cup cooked
- Asparagus (89mg) 4 spears
- Brussels sprouts (78mg) 1/2 cup
- Broccoli (52mg) 1/2 cup

## Mental Health and Cognitive Performance

Anxiety (Choline)




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

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

## Mental Health and Cognitive Performance

Anxiety (Glutamate and GABA)




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

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

## Mental Health and Cognitive Performance

Fear Response




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

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

## Mental Health and Cognitive Performance

Addiction


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

- Your genotype is associated with a improved density of dopamine receptors for the ANKK1 gene, increasing dopamine targets within the striatum of the brain and reducing addiction susceptibility

## Mental Health and Cognitive Performance

Reward System


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

- Your genotype is associated with a slightly higher dopamine response to reward processing that could improve motivation as well as decision making

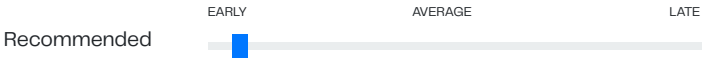
## Warrior or Strategist

Pressure Response


Your COMT genotype is associated with the "Hybrid" that has intermediate to high levels of dopamine and may be able to express the Warrior or Strategist traits depending on life experience. Higher dopamine is useful in complex environments that require maximal performance in terms of memory and attention for survival.

- If your levels of dopamine get too high and you find yourself irritable, impulsive, and stressed, add strength training 3-5 times a week and increase your magnesium and vitamin C intake for balance.
- Average to low catecholamine intake recommended (coffee, green tea, berries, chocolate)
- For men and premenopausal women, avoid IPA beers due to a higher estrogenic effect that can slow COMT down further

## Sleep Support

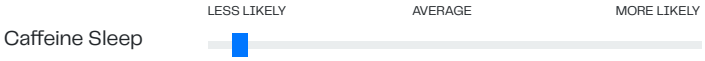



Recommended Wake Time

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

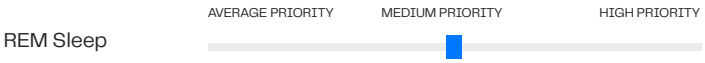



Caffeine Sleep Disturbance

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

- You are a fast metabolizer of caffeine, which means that you are less likely to have your sleep affected by caffeine

## Sleep Support



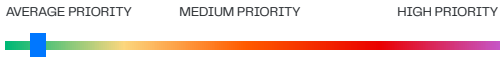

REM Sleep

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

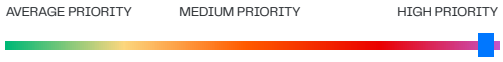



Your perception of stress is unique to your genotypes and life experience. Variants in 5-HT2A are associated with perceived stress, low vagal tone, anxiety, depression, OCD, and IBS, especially in females.

- 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

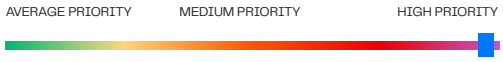

Weight lifting has a higher impact on hormonal pathways that may provide higher levels of stress relief based on the speed of these pathways.

- Your genotype is associated with slightly higher dopamine levels and a reduced clearance of adrenaline
- Weight lifting helps speed up the pathway responsible for clearing excess dopamine and adrenaline, and therefore is a useful tool for you to use for chronic stress


# 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 slower metabolism of xenoestrogens, and therefore the damage may be greater from xenoestrogen exposure
- Increasing magnesium targets the enzyme responsible for assisting xenoestrogen detoxification

## Toxin Sensitivity

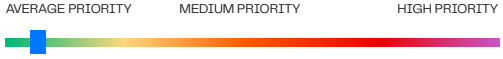
Occupational Toxins


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

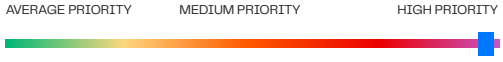
Formaldehyde


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

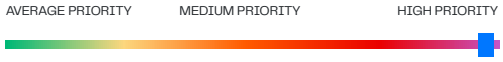



Benzo(a)pyrene is a carcinogenic compound produced from the burning of wood or trash, tobacco smoke, asphalt, coal, diesel exhaust, charred meat, and gas cooking.

- 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

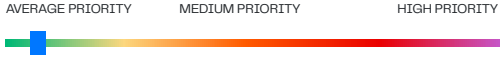



Aromatic amines are found in cigarettes, rubber factories, hair dyes that contain 4-aminobiphenyl, and meat cooked at high temperatures.

- Your genotype combinations are associated with a poor 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

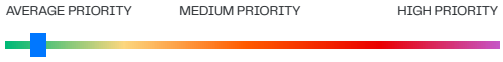



Sources of benzene include cigarette smoke, gasoline, exhaust, fires, industrial emissions, paint, detergent, glue, furniture wax, building materials, paint, petrochemical manufacturing, oil storage tanks, urban-industrial areas, service stations, certain foods, certain creams, groundwater contamination, 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 lower the sensitivity to aspartame
- Possible neurophysiological symptoms include learning problems, headache, seizure, migraines, irritable moods, anxiety, depression, and insomnia
- Artificial sweeteners in general increased waist circumference 500 percent while aspartame increased blood sugar in diabetes-prone mice
- Aspartame has been found to contribute to the formation of tumors in the CNS such as gliomas, medulloblastomas, and meningiomas, increased lymphoma and leukemia and, is an excitotoxin to brain neurons
- Aspartame in the body further metabolizes to formaldehyde, and rat studies found that formaldehyde (as a metabolite of aspartame) caused increased TSH levels and worsens the capacity of the gland leading to thyroid failure

## Toxin Sensitivity

Food Dyes


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

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

## Pesticides, Herbicides and Heavy Metal Sensitivity

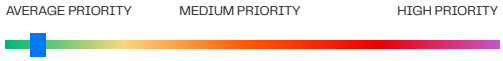
Glyphosate


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

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

## Pesticides, Herbicides and Heavy Metal Sensitivity

Organochlorines

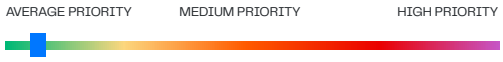



Organochlorines are found in certain pesticides, PCBs and sucralose.

- Your genotype is associated with improved protection against organochlorines

## Pesticides, Herbicides and Heavy Metal Sensitivity

Organophosphate Insecticides

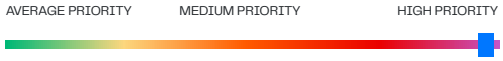



PON1 plays a large role in removing pesticides and is also involved with supporting HDL function and LDL oxidation. Organophosphates are a class of insecticides, including parathion and chlorpyrifos, that were among the most widely used insecticides available until the 21st century.

- Your PON1 genotype is associated with improved PON1 levels and detoxification of organophosphate insecticides

## Pesticides, Herbicides and Heavy Metal Sensitivity

Arsenic

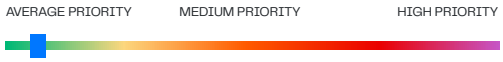



Arsenic is a heavy metal that is damaging at high levels. The highest dietary sources of inorganic arsenic include contaminated groundwater and rice. A consistent and growing body of evidence has shown that people who metabolize arsenic poorly may be at two to four times the risk of developing certain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

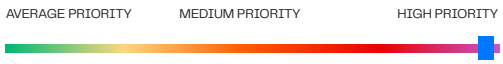



Chemical agriculture uses high amounts of synthetic organophosphates, creating a very high phosphorus content. Synthetic phosphorus concentrates the amounts of heavy metals, like cadmium in non-organic soils and food. Choosing organic produce is one of the best ways to avoid excess cadmium.

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

## Pesticides, Herbicides and Heavy Metal Sensitivity

Mercury

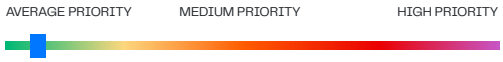



Mercury is a neurotoxin linked to neurological and behavioral disorders including tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction. Burning coal for power and heat is a major source of mercury exposure. Glutathione is responsible for protecting against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


# IMMUNE SUPPORT, ANTIOXIDANTS AND INFLAMMATION

## Bacteria, Yeast, Parasites and Viruses

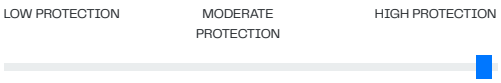
H. Pylori


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 boosted levels of thymidine, which may increase 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, a homozygous MTHFR 677 genotype is superior due to lower folate levels

## Bacteria, Yeast, Parasites and Viruses

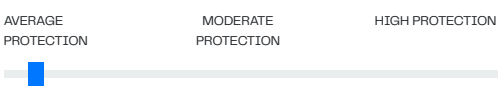
Norovirus


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 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

AVERAGE MEDIUM PRIORITY HIGH PRIORITY

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

AVERAGE MEDIUM PRIORITY HIGH PRIORITY

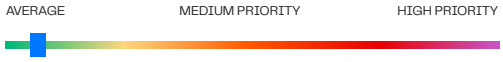
COVID-19 Viral Severity

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 69% 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 an average need for selenium
- Glutathione peroxidase 1 (GPX1) is a selenoenzyme with described antioxidant and antiviral properties that depends on nutritional selenium status
- Spain is at the top for meeting selenium requirements while Denmark is at the bottom
- The only two populations above the median of the countries analyzed included Finland and France, while the rest of the countries are below the general median

## COVID-19

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

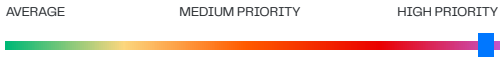

Glycine is one of the three major amino acids for glutathione production, protecting the body from oxidative damage during the immune response, and supporting T-cell proliferation.

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


# DNA PROTECTION & REPAIR

## DNA Protection & Repair

Glutathione Protection

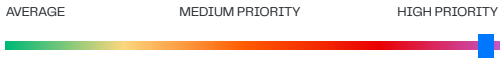



Glutathione is the master antioxidant system involved in oxidative stress, detoxification, and immunity. Glutathione status parallels telomerase activity, an important indicator of lifespan.

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

## DNA Protection & Repair

Catalase Protection




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

- Your genotype is associated with reduced catalase levels
- Low catalase increases the sensitivity to DNA damage from BPA plastic
- Foods high in flavonoids, the mushroom Lion's Mane, holy basil, cumin, anise, fennel, caraway, cardamom, and deep breathing practices all improve catalase levels

## DNA Protection & Repair

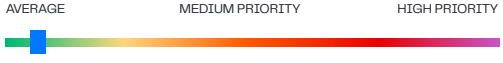
Mitochondrial Protection


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

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

## DNA Protection & Repair

UV Protection

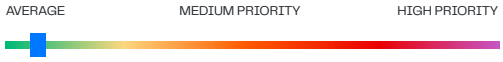



One hypothesis for variants in MTHFR 677 is that they were selected based on higher folate intake and UV exposure, both common in Mediterranean climates. What happens in the body when MTHFR enzymatic function is reduced is that thymidine production increases. Thymidine enhances the repair of UV-induced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

- Your MTHFR genotype is associated with increased UV protection from the sun

## DNA Protection & Repair

Skin Protection

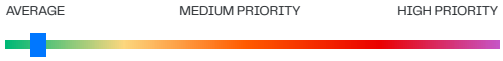



GPX1 activity is considered to be the most important antioxidant enzyme defense mechanism in the skin.

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

## DNA Protection & Repair

Lung Protection

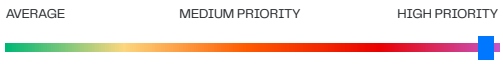



Variants in the GSTP1 gene have been associated with lower antioxidant support in the lungs when exposed to environmental pollution.

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

## DNA Protection & Repair

Lung Protection (Asian Ancestry)

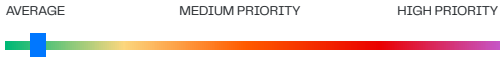



Glutathione levels and pro-inflammatory cytokines, such as TNF-a, are found in airways and environmental pollutants are known to induce inflammatory responses.

- 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


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 an average need for plants high in lutein, zeaxanthin, and anthocyanins for eye health

## DNA Protection & Repair


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.

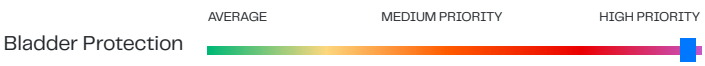
- Your genotype combination is associated with reduced thyroid protection and a slightly increased risk of Hashimoto's disease
- Autoimmune thyroid disease is associated with celiac disease
- A deficiency in selenium is associated with celiac disease and thyroid disease, and plays a significant role 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


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



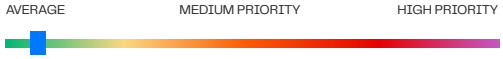

Certain gene combinations have been found to decrease the detoxification ability of certain toxins found to be carcinogenic for the bladder.

- 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


# CARDIOVASCULAR HEALTH & EXERCISE

## Cardiovascular Health

HDL and LDL

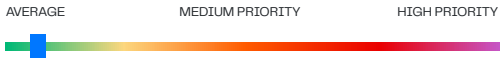



ApoE is connected to HDL and LDL levels, while PON1 is involved with supporting HDL function and LDL oxidation, an important mechanism in atherosclerosis and heart disease.

- 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

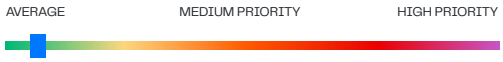



Subjects with variants in PPAR-alpha have been found to have a larger waist circumference and a higher proportion of small, dense LDL particle size.

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

## Cardiovascular Health

Triglycerides

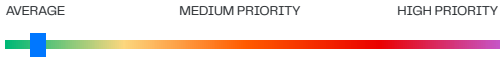



Variants in the FADS1 SNP (rs174546) are associated with elevated triglyceride levels.

- Your genotype is not associated with elevated triglycerides

## Cardiovascular Health

ApoB

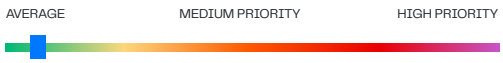



ApoB is a protein that is involved in the metabolism of lipids and is the main protein constituent of lipoproteins. High levels of ApoB, especially with the higher LDL particle concentrations, are the primary driver of arterial plaque. The PPAR-alpha polymorphism has been associated with ApoB in many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

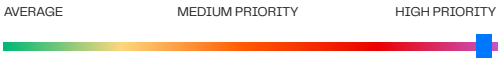
Raw Plant Intake


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

## Cardiovascular Health

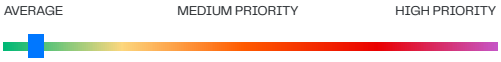
High Blood Pressure


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

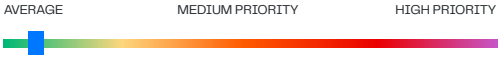



Deep vein thrombosis is a condition that occurs when a blood clot forms in a vein deep inside a part of the body and is most common for those over 60. Variants in F5 increase the risk of deep vein thrombosis.

- 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

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

## Exercise


Weight Lifting Inflammation

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

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

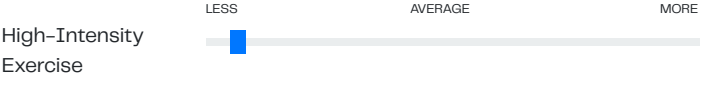
## Exercise


Endurance Exercise Inflammation

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

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

## Exercise



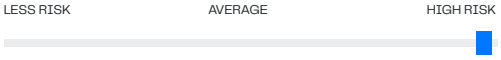

High-Intensity Exercise Inflammation

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

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

## Exercise

ACL and Shoulder Dislocation Risk

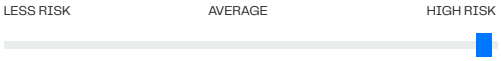



The COL1A1 gene is associated with ACL and shoulder injury risk.

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

## Exercise

Ankle and Hamstring Injury Risk

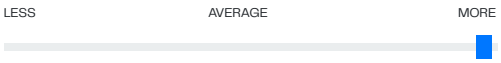



The ACTN3 gene is linked to increased or decreased risk of ankle and hamstring injuries.

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

## Exercise

Cold Endurance

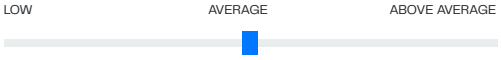



The ACTN3 gene is associated with a lower or higher adaptation rate to cold endurance.

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

## Exercise

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 may be associated with an average VO2 max training response
- Training in the cold, ashwagandha and eluethero root have been found to help increase VO2 max

## Exercise


Caffeine Response for Exercise Under 1 Hour

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

- Fast metabolizers have been found to show an increase in exercise performance for activities under 1 hour from caffeine consumption

## Exercise


Caffeine Response for Exercise Over 1 Hour

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

- Your CYP1A2 genotype is associated with a decrease in exercise performance activities over 1 hour from caffeine consumption due to being a fast metabolizer

# 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.
- **Fat Metabolism-ACSL1** - Your genotype is associated with improved glucose metabolism from saturated fat intake.
- **Saturated Fat-APOA2** - Your genotype is associated with a reduced likelihood of saturated fats causing weight gain.
- **Lactose** - You have the heterozygous AG genotype that is associated with a lower probability of lactose intolerance.
- **Histamines-APB1** - 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.

## DNA DAMAGE, PROTECTION AND REPAIR

- **DNA Repair-ATM** - Your genotype is associated with improved DNA repair function for pancreatic health.
- **Prostate-ESR2** - For men with the ESR2 rs2987983 wild-type AA genotype, your genotype is associated with an improvement in tumor suppressor gene function for prostate health and lowering phytoestrogen requirements. All genes related to prostate health should be analyzed to better determine the cumulative value for prostate protection.
- **DNA Repair-MDM2** - Your MDM2 genotype is associated with improved DNA repair for sun damage if you are female.
- **DNA Repair-MLH1** - Your genotype is associated with improved DNA repair for colon, endometrium, lung, and brain protection.
- **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.

## METHYLATION

- **Folate-MTHFR 677** - You have the homozygous genotype that is associated with improved protection against UV-induced DNA damage from the sun and a reduced risk of malaria.
- **Folate-MTHFR 1298** - Your genotype is associated with improved BH4 levels and neurotransmitter function. Healthy BH4 levels assist in the management of cardiovascular health, mental health, and digestive health.
- **B12, B2 and Zinc-MTR** - You may have improved MTR function, assisting homocysteine metabolism.
- **B12-TCN2** - Your genotype is associated with improved B12 transportation.
- **Arsenic-CBS** - Your genotypes are associated with improved arsenic metabolism and detoxification for the CBS genes.

## HORMONE SUPPORT

- **Sex Hormone Binding Globulin** - If you are female, your genotype is associated with helping maintain normal estrogen and testosterone levels. Other epigenetic factors like obesity, fatty liver, and Type 2 diabetes should be considered when assessing SHBG levels.
- **Testosterone-Men** - If you are male, your genotype is associated with improved total and free testosterone levels for the SHBG rs6258 gene.
- **Thyroid-DI01** - Your genotype is associated with 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-CYP1A2** - For men and women with the CYP1A2 AA genotype, coffee intake was found to be more protective against estrogen receptor-positive breast cancer and prostate cancer.
- **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-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 heterozygous genotype for COMT V158M and H62H scored significantly higher on insight problem-solving tasks and had a greater ability for social facilitation and cooperativeness.
- **Dopamine Receptors-ANKK1** - Your genotype is associated with an improved density of dopamine receptors for healthy dopamine levels.
- **Histamines and Migraines-DAO** - The wild-type CC genotype for DAO rs1049793 is associated with a reduced risk of histamine-induced migraine headaches.
- **Glutamate-BDNF** - Your genotype is associated with improved glutamate modulation, brain repair, spatial learning, memory, and adaptability.
- **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.

## IMMUNE SUPPORT, ANTIOXIDANTS AND INFLAMMATION

- **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-GPX1** - Your genotype is associated with improved selenium status and glutathione peroxidase to boost DNA protection, heat stress tolerance, skin protection and longevity.
- **Glutathione-CTH** - Your genotype is associated with improved gene function, leading to adequate cysteine for glutathione production.
- **Nitric Oxide-NOS2** - Your NOS2A gene is functioning optimally for reducing the probability of age-related macular degeneration from cigarette smoke.
- **Eye Health-CFH** - Your genotype is associated with improved antioxidant support for healthy eyes.
- **Eye Health-ARMS2** - Your genotype is associated with a lower sensitivity to the negative effects of smoking on eye health.

## DETOXIFICATION

- **Liver Enzyme-CYP1A1** - Your genotype is associated with improved detoxification of benzopyrene from cigarette smoke and will assist the function of your GSTM1 gene.
- **Liver Enzyme-THC and CYP2C9** - You have the wild-type genotype that is associated with improved metabolism of THC, the active psychoactive compound in cannabis.
- **Liver Enzyme-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.
- **Statins-COQ2** - Your genotype is associated with a lower likelihood of statin drug-induced muscle pain.

## CARDIOVASCULAR HEALTH & EXERCISE

- **Power and Recovery-ACTN3** - You have the XX genotype found at higher latitudes and lower temperatures that appears to be selected for cold climate adaptation and endurance. The XX genotype also results in a deficiency of the ACTN3 protein that decreases elite sprint and power performance. However, this deficiency may represent a survival phenotype adapted to thrive in the cold.
- **Pesticides, HDL and LDL-PON1** - You have the wild-type genotype associated with improved PON1 activity for pesticide detoxification and protection against LDL oxidation.
- **LDL-LPA** - Your genotype is associated with healthy Lp(a) levels, a sticky form of LDL that affects plaque levels.
- **Caffeine-CYP1A2** - You have the homozygous AA genotype and are a “rapid metabolizer” of caffeine. This means that caffeine will quickly be metabolized from your body and the effects lasting a shorter period of time. Variants in COMT can increase the sensitivity to catecholamines in coffee, and oral contraceptives can slow down caffeine metabolism.
- **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 AA 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.
- **Ghrelin and Appetite-FTO** - Your genotype is associated with higher ghrelin levels (hunger hormone) that could lead to overeating and abdominal weight gain, especially when combined with variants in the ANKK1 gene. 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.
- **Carbohydrates-TCF7L2** - Your genotype is associated with an increased probability of elevated blood sugar from refined sugar and grains. A diet low in refined sugar and flour, higher in protein and omega-3 fatty acids, glycine, diversified prebiotic foods, olive oil, cinnamon, turmeric, dark roast coffee and cordyceps mushrooms may be more beneficial.
- **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.

## 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.
- **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.

## METHYLATION

- **Folate-MTHFR 677** - You have the homozygous genotype that is associated with a reduced function of approximately 50-70%. This increases the need for riboflavin and methylfolate for normal homocysteine levels.
- **Folate-MTHFD1 G1958A** - Your genotype is associated with an increased need for folinic acid, the second most common type of folate after methylfolate.
- **Folate-DHFR** - Your genotype is associated with a reduced ability to break down synthetic folic acid, potentially blocking folate receptors, and is more impactful for those with variants in MTHFR 677. Folic acid is found in many supplements and fortified foods.
- **B12-MTRR** - Your genotype is associated with a potentially higher sensitivity to B12 deficiency if there are variants in MTR as well.
- **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

- **Vitamin D-CYP2R1** - Your genotype is associated with low circulating vitamin D levels that can affect immunity, breast health in women, and testosterone levels in men. Check your vitamin D levels and make sure you are in range.
- **Estrogen Metabolism-CYP2C19** - Individuals with the CC genotype for CYP2C19*17 are considered the normal metabolizer phenotype, which may lack the estrogen metabolism benefits of the ultra-rapid metabolizer phenotype. Please review all genes involved in estrogen metabolism for a complete picture of the process.
- **Estrogen Metabolism-COMT** - For estrogen metabolism and detoxification, those with the intermediate AG COMT V158M genotype may have an increase in harmful estrogen metabolites that can cause DNA damage. To reduce the risk of these metabolites, you should avoid xenoestrogens, manage stress levels, maintain gut health, increase magnesium intake, and consume green tea polyphenols.

## MENTAL HEALTH, NEUROTRANSMITTERS & COGNITIVE PERFORMANCE

- **Serotonin Receptor-Memory** - You have the heterozygous genotype that is associated with reduced episodic memory, the ability to recall details regarding personal experiences, specific events, and what exactly occurred, depending on your diet and lifestyle. Episodic memory can be enhanced with tryptophan, green or black tea, mindfulness training, increasing VO2 max, reduced reliance on smartphones, and a higher catecholamine, betaine, and choline intake depending on COMT, BDNF, and PEMT gene status.

- **Dopamine, Adrenaline and Estrogen-COMT** - The heterozygous AG COMT V158M genotype is associated with a slower breakdown of dopamine, adrenaline, and estrogen, creating higher circulating levels in response to stress due to variants in the COMT genes. This may increase your need for magnesium, vitamin C, strength training, and sprints to reduce stress levels.

- **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.

- **Cholesterol-APOE** - You have the ApoE e3/e4 genotype. While not as impactful as the e4/e4 genotype, research has found this genotype to be associated with increased plasma cholesterol, lower antioxidant protection, and a reduced ability to repair synapses and protect neurons. Read more under the Macronutrient Metabolism section under My Health Report.

## 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.

- **Cell Protection-CAT** - Your genotype is associated with lower catalase levels and a sensitivity to BPA plastic and cell damage. This increases the need for foods high in flavonoids, the mushroom Lion's Mane, holy basil, cumin, anise, fennel, caraway, cardamom, and deep breathing practices to improve catalase levels.

- **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.

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

## DETOXIFICATION

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

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

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

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

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

## CARDIOVASCULAR HEALTH & EXERCISE

- **Power and Recovery-ACTN3** - You have the XX genotype that is associated with a reduced hypertrophy response to resistance training, increased post-exercise damage from eccentric training (lowering phase of a rep), and an increased risk of ankle and hamstring injuries. More attention may be needed for ankle and hamstring exercises to prevent injury, rest days in-between eccentric training, post-workout recovery strategies like cold-water immersion, and maintaining muscle mass later in life.

- **VO2 Max-PPARGC1A** - Your genotype is associated with a higher need for more strategies to increase oxygen capacity for aerobic exercise, including a structured endurance program, cold exposure, and adaptogens. Your genotype in the GSTP1 rs1695 gene can also influence this result.

- **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.

- **Muscle Recovery-IL6** - You have the CG genotype that is associated with higher levels of creatine kinase - a marker of muscle damage - from workouts. To accelerate recovery, whey protein, cold water immersion, American ginseng, curcumin, allicin, optimal testosterone levels, vitamin C, and collagen protein have all been found to attenuate creatine kinase levels.

- **Muscle Injury-COL1A1** - You have the wild-type CC genotype that is associated with an increased need for dietary collagen for healthy skin, tendons, corneas, lungs, and bones. Vitamin C, zinc, copper, glycine, proline, lysine, and B6 are all precursors to collagen production.

- **Raw Fruit and Vegetable Intake-9p21** - You have the heterozygous genotype that is associated with an increased need for phytonutrients from a higher raw fruit and vegetable intake for a healthy heart.

# 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.

| | | |
|---|---|---|
|  | **B2** | Lamb, salmon, yogurt, liver and oyster mushrooms |
|  | **B6** | Wild salmon, yellowfin tuna, liver, chicken breast, unfiltered fermented drinks, pistachios, avocado, sweet potatoes, and spinach |
|  | **Beta-Carotene** | Sweet potatoes, carrots, spinach, squash, cantaloupe, and broccoli |
|  | **Betaine** | Spinach, shrimp, beets, and whole grain sourdough bread |
|  | **Copper** | Potatoes, shiitake mushrooms, cashews, sunflower seeds, dark chocolate, and shellfish |
|  | **Folate** | Collard greens, beets, black-eyed peas, raw spinach, asparagus, hummus, broccoli, romaine lettuce, parsley, liver, strawberries, oranges, and sprouted lentils |
|  | **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

**Magnesium**

Sprouted pumpkin seeds, hemp seeds, chia seeds, Gerolsteiner mineral water, spinach, wild salmon, and peanut butter

**Manganese**

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

**Polyphenols**

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

**Prebiotics**

Pistachios, leeks, asparagus, radicchio, bananas, garlic, kiwi, onions, artichokes, Tiger nuts, chicory root, yacon syrup and foods high in polyphenols

**Tryptophan**

Wild salmon, oats, bananas, eggs, chicken, turkey, chocolate, peanuts and pumpkin seeds

**Vitamin A**

Liver, pastured eggs, cod liver oil, wild salmon oil, eel, and sockeye salmon

**Vitamin C**

Bell peppers, guava, black currants, strawberries, oranges, and broccoli

**Vitamin D**

Sockeye salmon, cod liver oil, canned tuna, wild herring, and sardines

# PERSONALIZED BLOOD WORK

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

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

**B12**

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

**B6**

B6 levels may need to be tested

**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 R267S rs12934922 | Homozygous TT |
| BCMO1 A379V rs7501331 | Heterozygous CT |

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 | Homozygous CC |

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. Homozygotes have approximately a 2.90 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.



## Ghrelin and Appetite-FTO

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| FTO rs9939609 | Homozygous AA |
| FTO rs17817449 | Homozygous GG |

## Recap

Improves FTO Gene Function: A protein and fiber-rich breakfast, 7-8 hours of sleep per night, healthy vitamin D levels, and aerobic exercise over 1 hour or high-intensity exercise.

Decreases FTO Gene Function: Poor sleep patterns, refined carbohydrate breakfast, high saturated fat and low polyunsaturated fat intake, low vitamin D levels, and a sedentary lifestyle.

GHRELIN AND APPETITE-FTO

**Research**: The FTO gene is highly expressed in the brain regions controlling feeding and energy expenditure, and is one of many genes associated with being a risk factor for obesity, especially abdominal weight. Polymorphisms in the FTO gene have been shown to cause higher ghrelin levels in many populations, which can create a larger appetite and the potential for overeating.

FTO encodes for an enzyme able to remove methyl groups from DNA and RNA, and the FTO polymorphisms may reduce the methylation of ghrelin (hunger hormone), leading to higher ghrelin levels and potentially affecting other genes. Although rs9939609 has been replicated across a number of cohort studies for obesity, there remains significant variance due to epigenetic expression.

Studies have proposed that FTO alters dopamine signaling, affecting reward brain structures. This may be especially true for those who also have variants in ANKK1, the gene for dopamine receptor density. Research has shown that in cases of reduced D2 receptor availability, as indicated by the ANKK1 polymorphism, FTO variants were associated with increased body fat, waist circumference and reduced peripheral insulin sensitivity. This could increase the risk of obesity and Type 2 diabetes.

This may explain why the FTO rs9939609 homozygous genotype preferentially selects high calorie/high-fat food compared to the normal TT genotype. Multiple studies have shown that a high dietary saturated fat intake (higher than 15.5% energy) and a low dietary polyunsaturated fat intake further increased the risk of being overweight or abdominally obese for the AA genotype. The non-risk TT allele carriers appeared to be unresponsive to dietary saturated fat intake or the dietary polyunsaturated to saturated fat intake ratio in regards to obesity.

Grehlin is highest in the fasting state, before meals, and at night, falling within one hour of a meal. Research has found that a breakfast centered around protein and fiber-rich carbohydrates (especially prebiotic fiber) was the most effective at suppressing ghrelin levels throughout the day, while also focusing on polyunsaturated and monounsaturated fats.

In a single-blind crossover study, three high fat meals (70% of energy) rich in monounsaturated (MUFA), polyunsaturated (PUFA) or saturated fat (SFA) in 16 women with obesity were tested. A decrease in ghrelin was significantly greater for PUFA and MUFA vs. SFA while appetite suppression was significantly greater for PUFA vs. both SFA and MUFA. One study also found that subjects with vitamin D levels of less than 20ng/ml had significantly higher ghrelin levels than those with a vitamin D level greater than 20/ml.

People with the homozygous FTO genotypes may be more prone to overeating when eating a high-saturated fat meal or purely refined carbohydrate breakfast and getting poor sleep due to higher ghrelin levels. One study found that a reduction of sleep duration to 4-hours for two consecutive nights was shown to decrease circulating leptin levels and increase ghrelin levels, as well as self-reported hunger.

The key to improving FTO gene function is through lowering ghrelin levels, and those with the homozygous genotypes may gain the most significant benefits from preventative and treatment strategies aimed at targeting the ghrelin system and modulating reward responsiveness. The ANKK1 gene for dopamine receptors is also a relevant gene for appetite control and should be reviewed as well.



Regarding exercise, research has shown that doing 120 min prolonged treadmill exercise with mix intensity or high-intensity exercise was the most effective at suppressing ghrelin, while weight training or low-intensity exercise did not have the same

effects. If weight loss and appetite suppression is your goal, aerobic exercise with a mixture of high intensity may be the best approach.

We recommend reviewing ANKK1, PPAR-alpha, ACSL1, APOA2, ADIPOQ, SLC22A5, FUT2 and CYP2R1 if your goal is weight loss and you want to further assess your saturated fat metabolism.

## Carbohydrates-TCF7L2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| TCF7L2 rs7903146 | Heterozygous CT |

### Recap

Improves TCF7L2 Gene Function: A Paleolithic and low-carb Mediterranean diet, glycine, omega-3 fatty acids, olive oil, turmeric, cinnamon, prebiotics, organic dark roast coffee, and cordyceps mushrooms.

Decreases TCF7L2 Gene Function: Refined sugar and grains.

CARBOHYDRATES-TCF7L2

**Research**: The TCF7L2 gene has become the strongest indicator of Type 2 diabetes and gestational diabetes risk for multiple ethnicities in studies. A meta-analysis also found an association with breast, prostate and colon cancer risk, all of which are connected to blood sugar levels and the risk is reduced by many of the same nutrients that improve this gene's function. Other genes and family history need to be assessed for cancer risk and prevention.

This gene is unique in its relation to Type 2 diabetes because people with variants in TCF7L2 may not exhibit risk signs like obesity. In fact, they may have a low body mass index (BMI) and low triglycerides. The increased risk is hypothesized to be due to the effect of TCF7L2 on the sensitivity of the pancreatic ß-cells to incretins, not overall insulin sensitivity.

Incretins are hormones that are released from the gastrointestinal tract after a meal and regulate the amount of insulin secreted. The two most important incretin hormones are GLP-1 and GIP. Researchers believe that increasing incretin sensitivity may decrease the risk of type 2 diabetes.

One study found that the consumption of meals based on the Paleolithic diet (no grains or dairy) focusing on fish, polyphenol-rich foods, fiber-rich vegetables, and spices high in phytochemicals resulted in significant increases in incretin and increased perceived satiety (feeling full). All three test meals were normalized to contain 50 grams of carbohydrates. Sufficient protein in particular shows promise in the management of Type 2 diabetes by stimulating incretin, insulin secretion, and slowing gastric emptying.

Two clinical studies have demonstrated that plasma GLP-1 levels rise following the ingestion of gelatin, a protein extraordinarily rich in glycine. Another study found that higher levels of indolepropionic acid produced by good bacteria due to a diet higher in prebiotic fiber-rich food decreased the risk of Type 2 diabetes.

Spices also appear very effective. Turmeric significantly increases the secretion of the incretin GLP-1. Cinnamon lowers blood glucose usually within physiological levels without hypoglycemia and increases satiety, showing it may act by potentiating the effects of incretin hormones.

There is a progressive deterioration of beta-cell function in patients with Type 2 diabetes. In vitro studies demonstrated that pancreatic beta-cell viability increased dramatically with cordyceps extract treatment, implying that cordyceps protect beta cells. This is crucial for the TCF7L2 gene due to the communication between pancreatic beta cells and incretins. The researchers concluded that “the potential ability of cordyceps to preserve beta-cell function may afford a promising therapy for diabetes.”



## 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 DQ2.5 | HLA DQ2.5-rs2187668 | CC | | |
| HLA-DQ8 | HLA-DQ8-rs7454108 | TT | | |
| BCMO1 R267S<br>BCMO1 encodes the conversion rate from beta-carotene to vitamin A. | BCMO1 R267S-rs12934922 | | | TT |
| | BCMO1 A379V-rs7501331 | | CT | |
| FADS2<br>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 | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption and how much bifidobacteria you carry in your digestive tract. The rs601338 SNP is found in European, African and Indian populations. | FUT2-rs601338 | | AG | |
| NBPF3<br>NBPF3 has been associated with vitamin B6 levels. | NBPF3-rs4654748 | | | CC |
| SLC23A1<br>Solute carrier family 23 member 1 (SLC23A1) is one of the two transporters which aids in the absorption of vitamin C into the body. Polymorphisms in the gene are associated with reduced plasma vitamin C levels in the body. | SLC23A1-rs33972313 | CC | | |
| ACAT1-02<br>The ACAT gene converts protein and fat to ATP (energy) in the mitochondria, and plays an important role in cellular cholesterol homeostasis. | ACAT1-02-rs3741049 | | AG | |
| ADIPOQ<br>ADIPOQ encodes for adiponectin, a protein secreted by fat cells that affect insulin and glucose metabolism. Low levels of adiponectin play a role in obesity, insulin resistance and Type 2 diabetes. | ADIPOQ-rs2241766 | TT | | |
| HFE-C282Y<br>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 | | |

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

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| APB1<br>APB1 is encodes for the DAO enzyme to breakdown histamines primarily in the digestive tract. The homozygous genotype may increase the risk of migraines from histamines in women or a hypersensitivity to Aspirin in men. | APB1-rs10156191 | CC | | |
| ABCG2 (Q141K)<br>The ABCG2 (Q141K) gene is located at the membrane of kidney proximal tubule cells, where it mediates renal urate secretion. Variants in this gene are linked to reduced uric acid excretion. | ABCG2 (Q141K)-rs2231142 | GG | | |
| ALDH2<br>Alcohol metabolism in the liver most commonly involves the enzymes alcohol dehydrogenase and aldehyde dehydrogenase, metabolizing alcohol to acetaldehyde, and then to acetate. ALDH2 encodes for aldehyde dehydrogenase, and variants can affect the levels of acetaldehyde and therefore the carcinogenic effect of alcohol. | ALDH2-rs671 | GG | | |
| ADRB2<br>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<br>PPCDC is necessary for the biosynthesis of coenzyme A and variants in this SNP are associated with serum zinc levels. | PPCDC-rs2120019 | TT | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SELENBP1<br>The Protein Selenium Binding 1 gene codes for an integral membrane protein involved in antigen presentation and serum copper levels. | SELENBP1-rs2769264 | TT | | |
| TFR2<br>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 | Homozygous AA |

### Recap

Improves MTHFR 677 Gene Function: Riboflavin and methylfolate.

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

FOLATE-MTHFR 677

The highest cluster of the homozygous MTHFR 677 genotype is found in Mexico and Hispanics in the US, Italy, Northern China, Spain, and France. The lowest frequency is found in black people (within and outside Africa), Inuit, Finland, Canada, the Netherlands, Germany, and Russia.

The homozygous MTHFR 677 gene has been found to have a 50-70% reduced enzymatic function. One hypothesis is that the homozygous MTHFR genotype was selected based on higher folate intake and UV exposure, both common in Mediterranean climates. What also 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.

The sun also depletes folate due to UV radiation. However, darker skin - common in the Mediterranean - contains higher melanin levels, which helps protect against folate loss. Increased thymidine and darker skin protected against the hot sun of the Mediterranean. At the same time, the environment provided more folate-rich fruits and vegetables to supply more dietary folate for other biochemical functions.

Another hypothesis is that malaria exposure - caused by a parasite through mosquito bites and has been prevalent in the Eastern Mediterranean and Southeast Asia - altered the MTHFR genotype selection. The malaria parasite needs higher amounts of folate to survive and replicate. Reduced MTHFR function lowered folate levels and boosted levels of thymidine, which may increase lymphocyte replication and immune function in response to malaria.

One concern with the homozygous MTHFR 677 genotype is high homocysteine. High homocysteine has been implicated in amyloid buildup, DNA damage and cancer, mitochondrial dysfunction, cardiovascular disease, age-related macular degeneration, apoptosis of neurons and depression. Multiple studies have found that riboflavin is essential for MTHFR 677 and that the homozygous genotype is associated with high homocysteine when riboflavin status is low. Reduced levels of methylfolate can also lead to decreased production of neurotransmitters, reduced conversion of homocysteine to methionine, and reduced s-adenosylmethionine (SAMe) concentrations.

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

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



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

## Folate-MTHFD1 G1958A

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| MTHFD1 G1958A rs2236225 | Heterozygous AG |

### 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.

## Folate-DHFR

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| DHFR A20965G rs1643659 | Homozygous CC |
| DHFR C19483A rs1677693 | Homozygous TT |

### Recap

Improves DHFR Gene Function: Avoiding synthetic folic acid.

Decreases DHFR Gene Function: Synthetic folic acid, grapeseed extract and EGCG (green tea extract).

FOLATE-DHFR

**Research**: DHFR is needed for the intracellular conversion of synthetic folic acid, consumed in supplements and fortified foods, into the THF forms that can participate in folate/homocysteine metabolism.



High folic acid will also cause dihydrofolate to inhibit MTHFR. Reduction of DHFR enzymatic activity diminishes the THF pool inside the cell affecting the level of folate coenzymes and thus purine and pyrimidine synthesis.

You should consider avoiding all synthetic folic acid in supplementation and fortified food. This is especially true if breast cancer runs in your family.

Grapeseed extract is useful for staph infections by inhibiting DHFR. It also also useful along with EGCG for cancer through this mechanism by reducing folate. If you are taking either one and you do not have cancer, you will want to include methylfolate in your diet or supplementation. Folic acid, however, may increase cancer risk by inhibiting DHFR.

## B12-MTRR

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| MTRR A66G rs1801394 | Homozygous GG |

### Recap

Improves MTRR Gene Function: B12, B6 and folate.

Decreases Gene Function: Antacids, antibiotics, proton pump inhibitors, Metformin, anticonvulsants, oral contraceptives, certain psychiatric medications, yeast overgrowth and poor FUT2 function.

B12-MTRR

**Research**: Methionine synthase reductase (MTRR) is a vital enzyme of homocysteine/methionine metabolic pathway and is required for the conversion of inactive form of methionine synthase (MTR) to its active form. MTRR helps recycle B12. If MTR is working 100%, MTRR variants may be less pronounced. Variants in both MTR and MTRR may lead to issues with B12.

A clinically important allelic variant of MTRR A66G, with less enzymatic activity is reported with worldwide prevalence rate of 30%. The very high frequency of the homozygous genotype (greater than normal allele) was reported from Italy, France, Ireland, Netherlands and India.

Several epidemiological and case control studies have reported that the GG genotype may be a risk factor for several disease/disorders like neural tube defects, Down syndrome, coronary artery disease, male infertility and cancer through sustained hypomethylation if not addressed. An additional effect is a decreased availability of folate. Several studies show that DNA hypomethylation is the main causative factor of defective gene expression.

Caucasions with late life depression who were homozygous (GG) were more likely to still be depressed after a course of SSRI antidepressant treatment compared to individuals who are homozygous at the A allele or who were AG heterozygotes. This points toward the hypothesis that factors which elevate homocysteine concentrations have an adverse effect on depression treatment response.

Heterozygous or homozygous variants in MTRR may require more B6, folate and B12 if combined with MTHFR 677 and MTR variants. If you suffer from migraines, B6, folate and B12 may be effective in reducing migraines. Research has also found B6, folate and B12 to help prevent macular degeneration.

## 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<br>The MTHFR 677 gene encodes the MTHFR gene to convert folate into the active form, methylfolate. Variants in this gene slow down enzymatic function. | MTHFR 677-rs1801133 | | | AA |
| MTHFR 1298<br>MTHFR 1298 is involved in converting 5-methylfolate (5MTHF) to tetrahydrofolate (THF). Unlike MTHFR 677, the 1298 variant does not lead to elevated homocysteine levels unless paired with a heterozygous MTHFR 677. | MTHFR 1298-rs1801131 | TT | | |
| MTHFD1 G1958A<br>(Methylenetetrahydrofolate dehydrogenase 1) encodes a protein that possesses three distinct enzymatic activities in the interconversion of 1-carbon derivatives of tetrahydrofolate. | MTHFD1 G1958A-rs2236225 | | AG | |
| DHFR A20965G<br>Dihydrofolate reductase (DHFR) catalyzes the reduction of dihydrofolate to tetrahydrofolate (THF) and affect synthetic folic acid metabolism. | DHFR A20965G-rs1643659 | | | CC |
| | DHFR C19483A-rs1677693 | | | TT |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MTR A2756G<br>MTR (methionine synthase) combines folate, methyl B12 and homocysteine into methionine. | MTR A2756G-rs1805087 | AA | | |
| MTRR A66G<br>MTRR attaches a methyl group to B12 and variants here will slow the process. When both MTR and MTRR exist, dysfunction can occur. | MTRR A66G-rs1801394 | | | GG |
| TCN2 C766G<br>Transcobalamin II (TCN2, or holotranscobalamin when bound) transports B12 to peripheral tissues. Variants in this gene may affect B12 transport. | TCN2 C766G-rs1801198 | CC | | |
| PEMT<br>Variants in PEMT may increase the need for choline and increase the sensitivity to anticholinergic drugs. | PEMT-rs7946 | | CT | |
| | PEMT-rs12325817 | CC | | |
| CBS A13637G<br>The Cystathione Beta-Synthase (CBS) enzyme pulls homocysteine to hydrogen sulfide (H2S) and glutathione, requiring B6 and SAMe as a modulator. | CBS A13637G-rs2851391 | | | TT |
| CBS<br>The Cystathione Beta-Synthase (CBS) enzyme pulls homocysteine to hydrogen sulfide (H2S) and glutathione, requiring B6 and SAMe as a modulator. CBS rs234709 and rs4920037 assists in arsenic detoxification. | CBS-rs234709 | | CT | |
| | CBS 191150T-rs4920037 | | AG | |

# MY CLINICAL RESEARCH SUMMARY: HORMONE SUPPORT

## 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-CYP1A2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP1A2 rs762551 | Homozygous AA |

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.

ESTROGEN METABOLISM-CYP1A2

CYP1A2 is a key enzyme in caffeine metabolism and the 2-hydroxylation of the main estrogens, estrone, and estradiol. 2-hydroxylation and 16a-hydroxylation are two mutually exclusive pathways in estrogen metabolism. 2-hydroxyestrone acts as a weak estrogen or anti-estrogen. 16β-OHE1 acts as a procarcinogen.

Coffee may protect against breast cancer by altering estrogen metabolism. Women with higher coffee intake and the CYP1A2 homozygous AA fast metabolizer genotype have a ratio of high 2-hydroxyestrone to low 16β-OHE1. Researchers found that higher coffee intake was more protective against ER-positive breast cancer.

In men, a 2019 study found that low to moderate coffee intake and the AA fast caffeine metabolizer genotype were less likely to experience prostate grade cancer progression than non-consumers. In a large, pooled cohort of men with prostate cancer, coffee intake of more than 2.5 cups per day was associated with longer survival with the AA fast metabolizer genotype.

## Estrogen Metabolism-COMT

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| COMT rs4680 | Heterozygous AG |

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.

ESTROGEN METABOLISM-COMT

COMT is a phase II enzyme involved in the inactivation of catechol estrogens that can otherwise lead to cancerous growth, while also increasing 2-methoxyestradiol, a metabolite that has been shown to inhibit the growth of breast cancer cells.

Variants in COMT V158M have been shown to decrease enzymatic activity and consequently increases the risk of carcinogenesis due to the accumulation of estrogen metabolites. COMT has been extensively investigated for correlation with different cancer risks including esophageal cancer, colorectal cancer, hepatocellular, carcinoma, lung cancer, breast cancer, ovarian cancer, endometrial cancer, testicular germ cell tumor, and bladder cancer with mixed results.



Due to the COMT V158M heterozygous and homozygous genotypes potentially having reduced estrogen clearance, slowing this pathway down further with chronic stress and a high catecholamine intake combined with poor gut health and low magnesium intake may affect the level of harmful estrogen metabolites.

However, this doesn't mean catecholamines should be avoided. It simply means that the dosage should be altered. For

example, green tea has been found to be beneficial for breast cancer prevention in the COMT heterozygous and homozygous genotype because these individuals retained the polyphenols the longest. The wild type may need more to achieve the same benefit. Less is more for COMT variants.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SHBG<br>Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. | SHBG-rs1799941 | GG | | |
| | SHBG-rs12150660 | GG | | |
| SHBG<br>Sex Hormone Binding Globulin (SHBG) is synthesized in the liver, and in the blood it transports and regulates the access of sex steroids to their target tissues. Variants in this gene have been shown to lead to lower testosterone, calculated free testosterone and SHBG in men. | SHBG-rs6258 | CC | | |
| DI01<br>DI01 is connected to thyroid health and is responsible for the deiodination of T4 into T3. | DI01-rs2235544 | CC | | |
| DI02<br>DI02 is connected to thyroid health and is responsible for the deiodination of T4 into T3. D2 is the only activating deiodinase in the brain. | DI02-rs225014 | | CT | |
| CYP2R1<br>Vitamin D is technically a hormone, and CYP2R1 is connected to circulating vitamin D levels. | CYP2R1-rs10741657 | | | GG |
| CYP1A1<br>CYP1A1 is in the estrogen metabolism pathway along with CYP1B1, CYP1A2, CYP31A, SULT's and COMT. | CYP1A1-rs1048943 | TT | | |
| CYP2C19*17<br>Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens. | CYP2C19*17-rs12248560 | CC | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CYP1A2<br>CYP1A2 is a key enzyme in caffeine metabolism and the 2-hydroxylation of the main estrogens, estrone, and estradiol. | CYP1A2-rs762551 | | | AA |
| COMT<br>COMT is involved in catecholamine, dopamine, adrenaline, and estrogen metabolism through the inactivation of the catechol estrogens. | COMT-rs4680 | | AG | |
| FUT2<br>The FUT2 gene controls prebiotic production, B12 absorption, and how much bifidobacteria you carry in your digestive tract. | FUT2-rs601338 | | AG | |
| MTNR1B<br>The MTNR1B gene encodes for the melatonin receptor 1B. | MTNR1B-rs10830963 | CC | | |

# 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.

## Serotonin Receptor-Memory

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| 5-HT2A rs6314 | Heterozygous AG |

Recap

Improves Gene Function: Mindfulness training, meditation, yoga, exercise to fatigue, time in nature, strength training, green or black tea, tryptophan, B2, B6, B12, folate, and ginkgo biloba.

Decreases Gene Function: Chronic stress, high dose lithium, heavy cannabis use, and excessive smartphone use.

SEROTONIN RECEPTOR-MEMORY

**Research**: Serotonin plays an important role in memory formation and results suggest a possible role of 5-HT2A receptors in memory consolidation. Episodic memory is the ability to recall details regarding personal experiences, names of people, specific events, and what exactly occurred. It is this type of memory that is most affected by the serotonin gene 5-HT2A rs6314 and takes place mainly in the hippocampus of the brain.

Research has demonstrated a functional influence of the rs6314 SNP on human memory, with the A carriers showing 21% poorer episodic memory performance than the GG genotype. The A allele has been found with a frequency of 9.3% in Caucasian populations.

In one study, healthy young volunteers viewed six sets of semantically unrelated words and performed an incidental episodic memory task with immediate and delayed recall after 5 min and 24 hours. In both conditions, A carriers showed lower memory performance compared to the GG genotype. Moreover, it has been shown that this effect is modified by age in that it can be detected in young to middle-aged, but not in older populations. In another study, A carriers exhibited poor verbal delayed recall and recognition, but performed equivalent to controls on tests of immediate recall, attentional, and executive function. Further analysis showed A carries had reduced grey matter volume in the left hippocampus and left inferior temporal gyrus and, bilaterally, in the middle and superior temporal gyrus. The white matter was reduced in the left temporal regions as well.

Training in mindfulness, classically described as a receptive attentiveness to present events and experiences, has been shown to improve attention and episodic working memory. This training may have relevance for potential educational and occupational performance. An example of not being mindful and attentive would be getting distracted by a smartphone during a conversation or event, consequently missing visual and auditory cues for later storage. Harvard researchers found that after eight weeks, subjects spending 27 minutes per day on mindfulness exercises (like meditation) increased grey matter volume in the hippocampus, one of the most important sections of the brain for learning and memory.

Research has shown that the reliance on technology may be decreasing our ability to store long term memories. Researchers have argued that the reliance on smartphones and related technologies is not aiding mental functioning, but rather, is having a negative impact on our ability to think, remember, pay attention, and regulate emotion. Recent studies on memory and technology use found that participants who took pictures of an object vs. those who did not had a more difficult time recognizing these objects at a later date. Auditory memory was also impaired. Due to ubiquitous use of cameras on smartphones for day to day events, the consequences on long-term memory have yet to be researched.

Due to 5-HT2A receptor's role in BDNF regulation, the A allele for rs6314 was also found to cause a lower expression of BDNF in hippocampal neurons and potentially a decrease in neural plasticity. Theanine, a component of green tea and black tea, has been shown to increase BDNF levels, modulate serotonin and dopamine levels, and improve learning and memory. A human study that looked at matcha tea consumed in a realistic dose found that it can induce slight effects on speed of attention and episodic memory.

Cannabis use has been associated with episodic memory impairments and abnormal hippocampus morphology among both healthy individuals and schizophrenia subjects.

In a parallel, randomized and controlled trial, 88 patients diagnosed with exhaustion disorder participated in a 24-week multimodal rehabilitation program. After 12 weeks in the program, the patients were randomized to either a 12-week aerobic training intervention or to a control group with no additional training. The aerobic training group significantly improved in maximal oxygen uptake (VO2 max) and episodic memory performance.

Ginkgo biloba has been found to target the 5-HT2A serotonin receptor and improved episodic memory in patients with mild-cognitive impairment. However, it was not found to improve memory in young adults.

Episodic memory is believed to be affected by both the hippocampus and prefrontal cortex function. Due to acetylcholine's role in memory in the hippocampal region, researchers found that increasing acetylcholine levels improved visual episodic memory.



Research has shown that tryptophan depletion impairs episodic memory and verbal short-term memory function in human subjects, while rodent studies have also shown that tryptophan-free protein-carbohydrate mixture to rats significantly lowered hippocampus tryptophan levels and produced impaired performance in visual working memory. However, dietary tryptophan

was found to increase brain serotonin levels and improve memory in rats.

5-HT2A receptors are the most abundant serotonin receptor in prefrontal cortex and regulate the dopamine pathway. Researchers found that for those with the GG COMT V158M genotype (low dopamine), a COMT inhibitor improved verbal episodic memory and prefrontal cortex function, while the AA COMT V158M homozygous genotype (high dopamine) got worse. If you have the GG COMT V158M genotype, you may improve episodic memory through coffee, chocolate, green tea, black tea, citrus, and bananas by slowing down the COMT enzyme and increasing dopamine.

## Dopamine, Adrenaline and Estrogen-COMT

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| COMT V158M rs4680 | Heterozygous AG |
| COMT rs4633 | Heterozygous CT |

### 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.

Studies have found that the AG allele in COMT V158M (rs4680) results in an intermediate enzymatic function, while the wild type GG has fast activity, and the AA homozygous genotype has 4-5 times lower COMT activity. This means that dopamine and adrenaline levels should be more level in the AG genotype. However, multiple studies have shown that the AG genotype may fall on the higher end of the dopamine spectrum with cognitive tests.

Research has shown that individuals carrying the A allele of rs4680 or T allele of rs4633 scored significantly higher on insight problem-solving tasks, and for the COMT H62H rs4633 gene, the homozygous TT and heterozygous TC carriers had higher insight problem-solving scores than those with wild-type CC genotype.

A small study found 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.

There are both benefits and detrimental aspects to variants in COMT. The downside of the A allele in COMT V158 is that the body overreacts to stress and pressure that can lead to anxiety, depression, impulsiveness, obsessive behavior, irritability, ADHD and abnormal behavior. It can also create a sensitivity to a higher intake of catecholamines (coffee, black tea, green tea, red wine, chocolate), especially in a stressed state, leading to high dopamine and adrenaline levels making the stress response worse. However, green tea has been found to be beneficial for breast cancer prevention in the AG and AA genotype because these individuals retained the polyphenols the longest. Other genetic variants involved in dopamine transport and receptor function also influence this magnitude.

Having a heterozygous variant in COMT V158M may increase your need for magnesium, vitamin C, and healthy copper levels (not too high or low). Compound weight lifting (squats, bench press, deadlift), sprints, and chopping wood can assist a slow COMT enzyme by increasing testosterone levels, which speed up the pathway and lower the stress response. Supplementation of magnesium and vitamin C may be essential to modulate COMT due to low magnesium levels in the water and soil, or lack of freshly picked fruits and vegetables for vitamin C, and chronic stress levels.

## 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.

## Cholesterol-APOE

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| APOE rs429358 | Heterozygous CT |
| APOE rs7412 | Homozygous CC |

### Recap

Increases Gene Expression: Higher level of exercise, 7-8 hours of sleep per night, fasting 13-16 hours between dinner and breakfast, B-vitamins, omega-3 fatty acids, selenium, polyphenols, vitamin E, ashwagandha and lithium.

Decreases Gene Function: A high carbohydrate and sugar diet, smoking, high mercury or copper levels, chronic stress, elevated glucose, insulin resistance, traumatic brain injuries, high oxidative stress, air pollution, lithium deficiency and low glutathione peroxidase (GPX gene) activity.

CHOLESTEROL-APOE

**Research**: APOE is a cholesterol transporter and functions as a key regulator to coordinate the mobilization of cholesterol between cells and remove toxins. These functions are particularly critical for the nervous system where the APOE transport of cholesterol is critical for maintenance of brain neurons.

While over 60% of persons with Alzheimer's disease harbor at least one APOE-e4 allele, it has been recommended that the APOE-e4 test not be used for the prediction of Alzheimer disease risk because there are many other epigenetic factors at play.

The risk of cognitive decline conferred by carrying the E4 allele is greater among individuals from northern Europe. It is recommended that you look at ACSL1, TCF72, PEMT, CAT, SOD2, GPX, SHBG, MTHFR, FUT2 and GAD1 genes in the Nutrition Genome Report for a more comprehensive perspective on the pathways associated with Alzheimer's disease.

APOE evolved from the common hominid ancestor of humans and the great apes. While there are three main isoforms of APOE in humans (e2, e3, and e4), all great apes carry the APOE-e4 allele. The e4 genotype is found today in 15% of individuals. The E3 allele (found in 78% of people) is the most common in humans, especially in regions with a long-established agricultural economy. The ancestral E4 allele remains high in regions where an economy of foraging still exists or where food-supply is often scarce.

APOE-e4 may serve as an interesting example of antagonistic pleiotropy, a gene that confers an advantage in one period of life but later presents as a disadvantage. During the hunter-gatherer era, APOE-e4 appeared beneficial in protecting against miscarriage, stillbirth and certain infectious diseases evoked by both viruses and bacteria. The trade-off, however, was decreased injury repair to the brain and the symptoms likely didn't occur during the hunter-gatherer era due to a shorter life span. So it makes more sense for our species to select APOE-e4 because early life survival was a bigger threat. APOE-e4 carriers have also been shown to exhibit cognitive benefits earlier in life and higher intestinal absorption of dietary vitamin D and calcium, promoting stronger bones.

The predominance of this genotype during the hunter-gatherer era also gives a clue into the optimal diet for those with the APOE-e4 genotype. Much of the Paleolithic period would have had few grains and zero dairy, and hunter gatherers would have experienced longer fasting times. A high carbohydrate diet from grains would appear to be most problematic for this genotype. The amount and type of fat best for the E3/E4 and E4/E4 genotype is currently debated, however high amounts of saturated fats appear problematic. It is recommended you look at your fat metabolism genes in this report to determine fat intake.



Postmenopausal women constitute more than 60% of the affected Alzheimer population. A study from Nature found an increased risk for global cognitive decline and all-cause dementia respectively by 81% and 92% for older women breathing air that is heavily polluted by vehicle exhaust and other sources of fine particulates. The cognitive effects of air pollution are dramatically more pronounced in those with the APOE-e4 genotype.

The evidence is accumulating that oxidative stress and mitochondrial function is affected in APOE-e4 genotypes. Compared to the APOE-e2 and APOE-e3, APOE-e4 was also less effective in protecting cells from oxidative toxicity. Alzheimer's patients with the E4 allele show higher levels of hydroxyl radicals than Alzheimer's patients without an E4 allele and reduced levels of glutathione peroxidase, an enzyme with antioxidant capacity that is produced in the mitochondria. One study found that APOE has also been shown to induce the PON1 gene activity, and lower PON1 levels were observed in presence of APOE-e4. If your PON1 and GPX gene are also heterozygous or homozygous, focus should be on improving GPX function and PON1 to protect against LDL oxidation.

Research from the Buck Institute group found that APOE-e4 reduced expression of the antiaging protein, sirtuin 1 (SIRTI). The reduced expression of SIRTI was thought to impair beta-amyloid clearance observed in Alzheimer's. Further research determined that APOE-e4 bound to promoters of 1,700 genes that APOE-e3 did not, of which 76 are believed to be connected to Alzheimer's. In addition to SIRTI, APOE-e4 appears to repress two anti-inflammatory genes and one antiapoptotic gene. It would appear then that polyphenol activators of SIRT-1 that contain anti-inflammatory and apoptosis properties should be a priority. Polyphenols in food that stimulate the sirtuin genes include: piceatannol (metabolite of resveratrol), fisetin (strawberries, apples, grapes), quercetin (wine, peppers, berries, apples) and resveratrol (wine, blackberries, blueberries, pistachios, dark chocolate).

Increasing evidence has shown that APOE-e4 genotype is associated with poorer outcomes following traumatic brain injury (TBI), likely due to the reduced ability to repair synapses and protect neurons from injury. TBI's are associated with increased risk of Alzheimer's disease, and therefore the E4 genotype may be used to know your risk factors for certain sports or activities with a higher percentage of head injuries.

Amyloid plaques are the sticky buildup of proteins that accumulate outside nerve cells. While the cause is currently unknown, the protein divides improperly in Alzheimer's disease, creating a form called beta amyloid which is toxic to neurons in the brain. The current theory is that the APOE-e4 genotype shows a reduced clearance of beta amyloid. The removal of beta amyloid occurs during sleep, making eight hours of sleep per night critical.

According to a lecture given by Dr. Frank Longo at Stanford University, all of the research shows that 30 minutes of exercise a day for 5 days a week is the most effective exercise plan to reduce the risk of Alzheimer's disease by 40%. The most fascinating part? Exercise put those with the APOE-e4 variant and those without the e4 variant at almost the exact same level of beta-amyloid accumulation. Meanwhile, those with an e4 variant that didn't exercise had the highest beta-amyloid levels.

Researchers have demonstrated that when ashwagandha was added to ß-amyloid treated samples, the toxic effects were neutralized and ashwagandha root extract was neuroprotective against ß-amyloid induced neuropathogenesis. Researchers have also found that continued lithium treatment was associated with a reduction of the rate of dementia to the same level as that for the general population and can actually be neuroprotective or even enhance the growth of neurons.

Knowing if you are APOE-e4 appears to be useful as part of the whole genetic blueprint in determining dietary and exercise needs to prevent Alzheimer's if it runs in your family. Many individuals with the APOE-e4 allele never develop the disease and many patients with Alzheimer's disease do not have the APOE-e4 allele. Case studies have shown tremendous progress with diet, exercise and lifestyle changes for slowing and even reversing symptoms.

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MAO-A<br>MAO-A (Monoamine oxidase A) is a critical enzyme involved in breaking down important neurotransmitters such as serotonin, estrogen, norepinephrine, and dopamine. | MAO-A-rs6323 | TT | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| 5-HT2A<br>The 5-HT2A gene encodes for serotonin receptors found in the brain and central nervous system and is concentrated in the brain region essential for learning and cognition. Polymorphisms in rs6314 may result in reduced episodic memory in young and middle-aged individuals. | 5-HT2A-rs6314 | | AG | |
| 5-HT2A<br>The 5-HT2A gene encodes for serotonin receptors found in the central nervous system. Polymorphisms in rs6311 and rs6313 may contribute to a reduced capacity to regulate stress, low vagal tone, anxiety, depression, OCD, and IBS, especially in females. | 5-HT2A-rs6311 | CC | | |
| | 5-HT2A-rs6313 | GG | | |
| COMT V158M<br>COMT is connected to dopamine, adrenaline, estrogen and catecholamine metabolism. | COMT V158M-rs4680 | | AG | |
| | COMT-rs4633 | | CT | |
| ANKK1<br>ANKK1 modulates the density of dopamine receptors in the brain. | ANKK1-rs1800497 | GG | | |
| DAO C2029G<br>DAO participates in the degradation of extracellular histamine. This gene is connected to migraines. | DAO C2029G-rs1049793 | CC | | |
| HNMT C314T<br>Histamine N-methyltransferase (HNMT) is a histamine-metabolising enzyme expressed in the brain. This gene is connected to migraines. | HNMT C314T-rs11558538 | | CT | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| HNMT<br>Histamine N-methyltransferase (HNMT) is a histamine-metabolising enzyme expressed in the brain. This gene is connected to hyperactivity and food dyes. | HNMT-rs1050891 | | AG | |
| FAAH<br>FAAH (fatty acid amide hydrolase) is a gene that encodes for anandamide breakdown, a neurotransmitter and endogenous cannabinoid. | FAAH-rs324420 | CC | | |
| PEMT<br>Choline is required for acetylcholine, a neurotransmitter of the vagus nerve that enervates numerous organs. | PEMT-rs7946 | | CT | |
| | PEMT-rs12325817 | CC | | |
| GAD1<br>GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA. | GAD1-rs3749034 | GG | | |
| BDNF<br>BDNF is a synaptic modulator of glutamate while GABA synapses are also regulated by BDNF. | BDNF-rs6265 | CC | | |
| SLC17A7<br>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<br>Apolipoprotein E (APOE) is a lipid binding protein that transports triglycerides and cholesterol in multiple tissues, including the brain. | APOE-rs429358 | | CT | |
| | APOE-rs7412 | | | CC |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| GAD1<br>GAD1 stands for “Glutamate Decarboxylase 1” and is responsible for the conversion of glutamate to GABA. | GAD1-rs3791851 | TT | | |
| | GAD1-rs2241165 | | | TT |
| | GAD1-rs3791850 | GG | | |
| | GAD1-rs769407 | GG | | |

# MY CLINICAL RESEARCH SUMMARY: DETOXIFICATION

## Liver Enzyme-CYP1A2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
|---|---|
| CYP1A2 C164A rs762551 | Homozygous AA |

### 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 homozygous (AA) rs762551 genotype, which is the rapid 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.

## Liver Enzyme-CYP2D6

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP2D6 T100C rs1065852 | Heterozygous AG |

### Recap

Improves CYP2D6 Gene Function: Unknown.

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

LIVER ENZYME-CYP2D6

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

## Aromatic Amines-NAT2

Below is a summary of your most significant variant genotypes:

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

### Recap

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

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

AROMATIC AMINES-NAT2

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

Generally, the NAT2 phenotype can be classified into slow, intermediate, and rapid acetylator. The AA genotype is the slow acetylator, and numerous studies have associated the NAT2 slow acetylator phenotype with bladder cancer risk in smokers found in America, Europe, and Asia. However, in nonsmokers, rs1495741 AA did not increase susceptibility to bladder cancer when compared to GG and AG genotypes.

Exposure to aromatic amines has been found to increase the risk of breast cancer in those that work in rubber factories, use hair dyes that contain 4-aminobiphenyl (which also affects Tp53), and consistently consumed meat cooked at high

temperatures. Research has shown the aromatic amine formed with meat cooked at high temperatures may cause both DNA damage and cause the proliferation of estrogen-sensitive cancer cells.

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

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

## Vitamin K2-VOKRC1*2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| VKORC1*2 rs9923231 | Heterozygous CT |

### 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<br>CYP1A1 is in the estrogen metabolism pathway along with CYP1B1, CYP1A2, CYP31A, SULT's and COMT. CYP1A1 is involved in the metabolism of benzopyrene. | CYP1A1*2C 4889-rs1048943 | TT | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| CYP1A2 C164A<br>CYP1A2 metabolizes various environmental procarcinogens, such as heterocyclic amines, nitrosamines, aflatoxin B1 and ochratoxin A. | CYP1A2 C164A-rs762551 | | | AA |
| CYP1B1*6 L432V<br>The CYP1B1 gene metabolizes pro-carcinogens such as polycyclic aromatic hydrocarbons and 17 beta-estradiol. | CYP1B1*6 L432V-rs1056836 | GG | | |
| CYP2C9*3 A1075C<br>Variants in CYP2C9 rs1057910 may alter the metabolism of THC, the psychoactive compound found in cannabis. | CYP2C9*3 A1075C-rs1057910 | AA | | |
| CYP2D6 T100C<br>CYP2D6 metabolizes approximately 50% of drugs in clinical use. | CYP2D6 T100C-rs1065852 | | AG | |
| CYP2E1<br>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<br>The CYP3A4 enzyme is involved in the metabolism of approximately 50% of drugs that are used today, cholesterol homeostasis, and the oxidative deactivation of testosterone. | CYP3A4*1B-rs2740574 | TT | | |
| CYP2C19*17<br>Genetic variability impacts expression and activity of CYP2C19 and therefore can influence drug metabolism and catabolism of estrogens. | CYP2C19*17-rs12248560 | CC | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| NAT2<br>The NAT2 gene encodes an enzyme that functions to activate and deactivate arylamine, hydrazine drugs, and carcinogens. | NAT2-rs1495741 | | | AA |
| VKORC1*2<br>Variants in VOKRC1*2 may increase the need for vitamin K2 and a sensitivity to dosing of the drug Warfarin. | VKORC1*2-rs9923231 | | CT | |
| COQ2<br>The COQ2 gene encodes an enzyme that functions in the final steps in the biosynthesis of CoQ10 and homozygous variants may increase the risk of statin induced myopathy. | COQ2-rs4693596 | TT | | |

# 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.

## Cell Protection-CAT

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CAT C-262T rs1001179 | Homozygous TT |

Recap

Improves CAT Gene Function: Black cumin seed oil, ginger, Lion's Mane, flavonoids, healthy iron levels, selenium, boron, cumin, anise, fennel, caraway, cardamom, lutein, holy basil and deep breathing relaxation techniques.

Decreases CAT Gene Function: Oxidative stress and BPA plastic.

CELL PROTECTION-CAT

**Research**: 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.

There are several SNPs identified in the CAT gene, of which the rs1001179 polymorphism (C262T) is the most extensively studied. In comparison with the variant C allele, the variant T allele of the CAT C262T polymorphism has been reported to indicate lower CAT enzymatic activity, higher sensitivity to oxidative stress, and increased DNA damage risk, which can lead to cancer.

If you have variants in CAT C26T, you may have a higher need for flavonoids, selenium, ginger, cumin, anise, fennel, caraway, cardamom, watching iron levels, and deep breathing relaxation techniques (yoga, meditation, prayer) to assist catalase.

Ginger consumption has been reported to decrease lipid peroxidation and normalize the activities of superoxide dismutase and catalase, as well as GSH and glutathione peroxidase, glutathione reductase, and glutathione-S transferase.

Lion's Mane has been found to promote ulcer protection and significant protection activity against gastric mucosal injury by preventing the depletion of antioxidant enzymes. Treatment with a hot water extract of Lion's Mane decreased lipid peroxidation and increased superoxide dismutase (SOD) and catalase (CAT) activities, quenching free radicals in the gastric tissue of ethanol-induced rats to exhibit gastroprotective activity.

## 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.

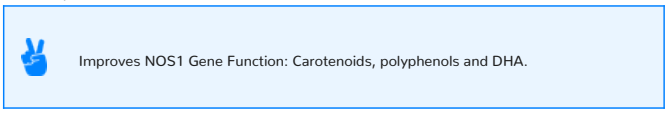
In healthy control subjects, the effect of a-tocopherol supplementation on the production of inflammatory cytokines appears to be dependent on an individual's GSTP1 rs1695 genotype. These genotype-specific differences may help explain some of the discordant results in studies that used vitamin E. Persons 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.

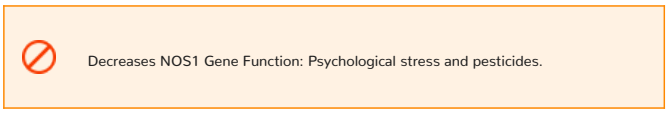
## Nitric Oxide-NOS1

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| NOS1 rs3782218 | Heterozygous CT |

### Recap




NITRIC OXIDE-NOS1

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

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



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

inflammatory genes and the level of intracellular antioxidants.

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

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SOD2<br>Superoxide dismutase (SOD2) is manganese dependent and protects against superoxide for the mitochondria of the cell. Variants here increase the need for intracellular antioxidant protection. | SOD2-rs4880 | | AG | |
| SOD3<br>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<br>CAT makes an enzyme called catalase, which helps reduce oxidative stress. | CAT C-262T-rs1001179 | | | TT |
| GSTM1<br>GSTM1 catalyzes the detoxification of alkyl and polycyclic aromatic hydrocarbons (PAHs), intermediate forms of many carcinogens, specifically metabolically generated epoxide intermediates of benzo(a)pyrene. | GSTM1-rs366631 | AA | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| GSTP1 I105V<br>Glutathione S-Transferase (GSTP1) is linked to the metabolism of mutagens, carcinogens, and other poisonous chemicals. It plays a crucial role in the detoxification process, thereby protecting cells from these compounds. GSTP1 rs1695 is connected to breast, prostate, urinary, esophagus, and skin health. | GSTP1 I105V-rs1695 | | AG | |
| GSTP1 C341T<br>Glutathione S-Transferase (GSTP1) is linked to the metabolism of mutagens, carcinogens, and other poisonous chemicals. It plays a crucial role in the detoxification process, thereby protecting cells from these compounds. GSTP1 rs1138272 is connected to the colon, prostate, lung, throat, and fertility. | GSTP1 C341T-rs1138272 | CC | | |
| GPX1<br>The GPX1 (Glutathione peroxidase 1) gene encodes a protein responsible for the modulation and detoxification of hydroperoxides and hydrogen peroxide to protect the mitochondria and cytoplasm of cells against oxidative damage. | GPX1-rs1050450 | GG | | |
| CTH<br>The CTH (Cystathionine Gamma-Lyase) gene encodes an enzyme in the trans-sulfuration pathway that converts cystathionine derived from methionine into cysteine. Glutathione synthesis in the liver is dependent upon the availability of cysteine. | CTH-rs1021737 | GG | | |

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

# MY CLINICAL RESEARCH SUMMARY: DNA PROTECTION, DAMAGE & REPAIR

## 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 |
|---|---|---|---|---|
| XRCC3<br>XRCC3 participates in DNA double-strand break/recombination repair. | XRCC3-rs861539 | | AG | |
| ATM D1853N<br>ATM coordinates DNA repair by activating enzymes that fix double stranded DNA breaks. | ATM D1853N-rs1801516 | GG | | |
| ESR2<br>ESR2 acts as a tumor suppressor gene that codes for estrogen receptor beta (ER-beta), one of two main types of estrogen receptor activated by estrogen. ESR2 is strongly expressed in the prostate. | ESR2-rs2987983 | AA | | |
| TP53<br>TP53 is a tumor suppressor gene responsible for DNA repair. | TP53-rs1042522 | | CG | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| MDM2<br>Variants in the MDM2 gene encode a protein that reduces cellular levels of the p53 tumor suppressor protein. | MDM2-rs2279744 | TT | | |
| MLH1<br>MLH1 codes for a DNA repair enzyme linked to colon health. | MLH1-rs1800734 | GG | | |
| GATA3<br>GATA3 factors are involved in cellular maturation with proliferation arrest and cell survival. | GATA3-rs4143094 | | GT | |
| SIRT1<br>SIRT1 senses changes in intracellular NAD+ levels and plays a role in DNA damage and repair. | SIRT1-rs7895833 | AA | | |

# 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 | Homozygous TT |

### Recap

Improves ACTN3 Gene Function: Not applicable for ACTN3.

Decreases ACTN3 Gene Function: Not applicable for ACTN3.

POWER AND RECOVERY-ACTN3

The XX (TT) genotype is a loss-of-function variant that results in a complete lack of expression of -actinin-3 and Type II muscle fibers; the deficiency occurs in approximately 20% of the world's population. The X allele can be traced back over a million years. The frequency correlates with higher latitude and lower temperature, showing a possible selection for cold tolerance and famine. Researchers found that the selection of XX appears to be for more fatigue-resistant muscles that generate heat from activation of brown adipose tissue, providing a tentative explanation for the evolutionary advantage of carrying the XX genotype in a cold climate.

The XX genotype frequency differs across ethnic groups. Approximately 25% of Asians, 18% of Caucasians, 11% of Ethiopians, 3% of Jamaican and US African Americans, and 1% of Kenyans and Nigerians possessing the XX genotype.

Studies in both Ironman athletes and ultra runners found that the XX genotype experienced the most amount of muscle pain and damage after the competition as measured by serum concentrations of myoglobin, creatine kinase, lactate dehydrogenase, and aspartate aminotransferase. However, there was no difference in race time or perceived exertion between all three genotypes.

ACTN3 XX homozygotes presented higher serum creatine kinase concentrations and self-reported pain scores than RR homozygotes after 20 maximal eccentric knee extensions. The same was true of soccer players after an eccentric training practice that included jumps, changes of direction, accelerations, and decelerations. However, it was not true with eccentric elbow flexion exercise or drop jumps, showing that specific lower body activities may be the most relevant. Your IL6 gene should be assessed, which could compound or reduce creatine kinase levels.

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

Of the eight studies identified that examined the impact of this polymorphism on post-exercise muscle damage, six reported that that the XX genotype was associated with higher levels of markers associated with muscle damage.

Both alpha-actinin-3 (encoded for by ACTN3) and alpha-actinin-2 are major structural components of the Z-disks within muscle fibers. The Z-disk itself is vulnerable to injury during eccentric contractions, and ACTN3 deficiency may increase this vulnerability with eccentric contractions in the ankle and hamstring.



More attention is recommended to strengthen the ankles and hamstrings (Nordic hamstring exercise) and post-workout recovery methods for injury prevention in the XX genotype. While the Nordic hamstring exercise is recommended due to the eccentric movement, the XX genotype would have increased muscle soreness and damage following this exercise, making timing and recovery days key within a training program.

Researchers have stated that the ACTN3 genotype could be utilized alongside other well-established markers to determine training intensity in the days following a match. Players genetically predisposed to increased muscle damage, either having a more extended recovery period or increased recovery interventions such as cold-water immersion.

Exercise phenotypes have played a key role in ensuring survival over human evolution. The saying "life is a marathon, not a sprint," could describe ACTN3 and endurance genes. Elite endurance athletes tend to live longer than power athletes, and genotypes related to endurance performance may also be correlated with living over 100.

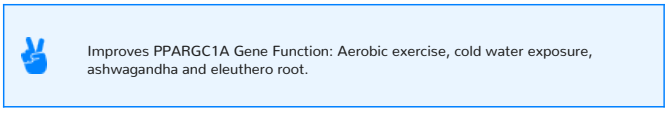
The ACTN3 genotype of centenarians resembles that of world-class elite endurance athletes and differs from that of elite power athletes. Researchers suggest a specific 'survival' advantage brought about by alpha-actinin-3 deficiency and the endurance oxidative muscle phenotype with other benefits still being explored.

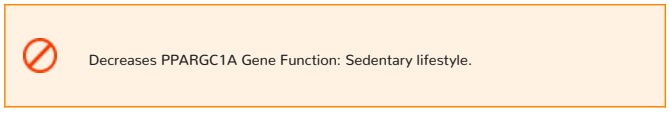
## VO2 Max-PPARGC1A

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| PPARGC1A rs8192678 | Heterozygous CT |

### Recap




VO2 MAX-PPARGC1A

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

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

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

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

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

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



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

## 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.

## Muscle Recovery-IL6

Below is a summary of your most significant variant genotypes:

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

Recap

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

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

MUSCLE RECOVERY-IL6

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

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

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

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

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

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

## Muscle Injury-COL1A1

Below is a summary of your most significant variant genotypes:

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

Recap

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

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

MUSCLE INJURY-COL1A1

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

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

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



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

## Caffeine-CYP1A2

Below is a summary of your most significant variant genotypes:

| GENE | GENOTYPE |
| --- | --- |
| CYP1A2 C164A rs762551 | Homozygous AA |

### 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 homozygous AA genotype and are a “rapid metabolizer” of caffeine. This means that caffeine will quickly be metabolized from your body and the effects lasting a shorter period of time. It is important to review your COMT gene function to better understand a sensitivity to coffee intake.

For the AA genotype, caffeine decreased 40-km time in cyclists by an average of 3.8 minutes in the AA homozygotes as compared to 1.3 minutes in the C allele carriers.

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

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| SOD2<br>Superoxide dismutase (SOD2) is manganese dependent and protects against superoxide for the mitochondria of the cell. The homozygous genotype increases the need for antioxidant support in high-intensity athletes. | SOD2-rs4880 | | AG | |
| COL1A1<br>COL1A1 produces alpha 1 chain of type I collagen, a major protein in tendons and ligaments. | COL1A1-rs1800012 | CC | | |
| PON1<br>PON1 (Paraoxonase) plays a large role in removing pesticides. It is also involved with supporting HDL function and LDL oxidation. | PON1-rs662 | TT | | |
| LPA<br>Lp(a)is a sticky form of LDL that appears to affect plaque growth, LDL particle size and increase the risk of plaque rupture and blood clotting. | LPA-rs3798220 | TT | | |
| CYP1A2 C164A<br>Variants in CYP1A2 determine caffeine metabolism and effects on bone density and cardiovascular health. | CYP1A2 C164A-rs762551 | | | AA |
| 9p21<br>9p21 is considered an important genetic marker for cardiovascular health. | 9p21-rs4977574 | | AG | |
| FADS1<br>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 |
|---|---|---|---|---|
| F5<br>Variants in F5 increase the risk of deep vein thrombosis, especially if using oral contraceptives. | F5-rs6025 | CC | | |
| ADRB2<br>Beta-2 adrenergic receptor (ADRB2) is abundantly expressed in cardiac cells, and bronchial smooth muscle cells and is connected to stress levels and heart health. | ADRB2-rs1042713 | GG | | |
| ACE1 G2350A<br>ACE1 is part of the renin-angiotensin system responsible for the conversion of angiotensin I to angiotensin II, constricting blood vessels and elevating blood pressure. | ACE1 G2350A-rs4343 | | AG | |
| ADD1<br>Variants in ADD1 are associated with hypertension in Asians. | ADD1-rs4961 | GG | | |
| AGTR1<br>Angiotensin-II receptor type 1 (AGTR1) is a major component of the renin-angiotensin system for regulating blood pressure and is highly expressed in adipose tissue, liver, leukocytes and the intestine. The homozygous genotype may increase the risk of high blood pressure from excess dietary fat and carbohydrate intake. | AGTR1-rs5186 | | AC | |
| ACE2 A8790G<br>ACE2 is part of the renin-angiotensin system, responsible for degrading angiotensin II and providing balance to ACE1 by dilating blood vessels and lowering blood pressure. | ACE2 A8790G-rs2106809 | AA | | |

| Gene & Gene Function | Gene Rsid | Wild Type | Heterozygous | Homozygous |
|---|---|---|---|---|
| TMPRSS2<br>Transmembrane Serine Protease 2 is highly expressed in the prostate and lungs, and the expression is associated with viral susceptibility and prostate cancer. | TMPRSS2-rs2070788 | | | AA |

## Sources

Please click the link below if you'd like to browse peer-reviewed studies referenced by this analysis:

https://www.mydna.life/wp-content/uploads/myDNA-Comprehensive-Health-Report-references.pdf