Physician Copy

GENOVA DIAGNOSTICS

63 Zillicoa Street
Asheville, NC 28801

NutrEval™ Plasma amino acids

Patient: **FEMALE TEST**

NutrEval Results Overview

Antioxidants

Normal	Borderline	High Need	Supplementation for High Need
Vitamin A / Carotenoids			
Vitamin C			
Vitamin E / Tocopherols			
	α-Lipoic Acid		
CoQ10			

B-Vitamins

Normal	Borderline	High Need	Supplementation for High Need
	Thiamin - B1		
		Riboflavin - B2	Riboflavin - B2 - Dose = 50 mg
Niacin - B3			
Pyridoxine - B6			
Biotin - B7			
Folic Acid - B9			
Cobalamin - B12			

Minerals

Normal	Borderline	High Need	Supplementation for High Need
Magnesium			
Manganese			
Molybdenum			
Zinc			

Vitamin D

Normal	Borderline	High Need	Supplementation for High Need
		Vitamin D	Vitamin D - Dose = 4,000 IU

SUGGESTED SUPPLEMENT SCHEDULE

Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Antioxidants			
Vitamin A / Carotenoids	2,333 IU	3,000 IU	
Vitamin C	75 mg	250 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		100 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.1 mg	25 mg	
Riboflavin - B2	1.1 mg	50 mg	
Niacin - B3	14 mg	20 mg	
Pyridoxine - B6	1.5 mg	10 mg	
Biotin - B7	30 mcg	100 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	100 mcg	
Minerals			
Magnesium	320 mg	400 mg	
Manganese	1.8 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	8 mg	10 mg	
Essential Fatty Acids			
Omega-3 Oils	500 mg	1,000 mg	
Digestive Support			
Probiotics		10 billion CFU	
Pancreatic Enzymes		0 IU	
Other Vitamins			
Vitamin D	800 IU	4,000 IU	

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	473	Methionine	0
Asparagine	0	Phenylalanine	52
Cysteine	165	Serine	0
Glutamine	64	Taurine	40
Glycine	0	Threonine	0
Histidine	0	Tryptophan	0
Isoleucine	200	Tyrosine	196
Leucine	415	Valine	291
Lysine	0		

Recommendations for age and gender-specific supplementation are set by comparing levels of nutrient functional need to optimal levels as described in the peer-reviewed literature. They are provided as guidance for short-term support of nutritional deficiencies only.

The Suggested Supplemental Schedule is provided at the request of the ordering practitioner. Any application of it as a therapeutic intervention is to be determined by the ordering practitioner.

Key: Normal (green) · Borderline (yellow) · High Need (red)

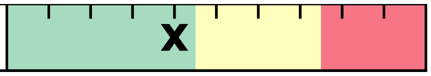
Note: Borderline — α-Lipoic Acid, Thiamin - B1, Omega-3 Oils; High Need — Riboflavin - B2, Vitamin D; all other patient recommendations Normal.

Interpretation At-A-Glance

Nutritional Needs

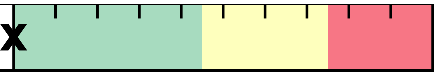
Antioxidants

Vitamin A / Carotenoids



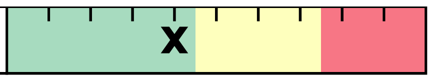
- Beta-carotene & other carotenoids are converted to vitamin A (retinol), involved in vision, antioxidant & immune function, gene expression & cell growth.
- Vitamin A deficiency may occur with chronic alcoholism, zinc deficiency, hypothyroidism, or oral contraceptives containing estrogen & progestin.
- Deficiency may result in night blindness, impaired immunity, healing & tissue regeneration, increased risk of infection, leukoplakia or keratosis.
- Food sources include cod liver oil, fortified cereals & milk, eggs, sweet potato, pumpkin, carrot, cantaloupe, mango, spinach, broccoli, kale & butternut squash.

Vitamin C



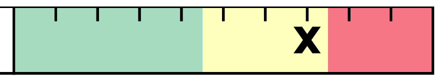
- Vitamin C is an antioxidant (also used in the regeneration of other antioxidants). It is involved in cholesterol metabolism, the production & function of WBCs and antibodies, and the synthesis of collagen, norepinephrine and carnitine.
- Deficiency may occur with oral contraceptives, aspirin, diuretics or NSAIDs.
- Deficiency can result in scurvy, swollen gingiva, periodontal destruction, loose teeth, sore mouth, soft tissue ulcerations, or increased risk of infection.
- Food sources include oranges, grapefruit, strawberries, tomato, sweet red pepper, broccoli and potato.

Vitamin E / Tocopherols



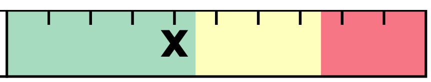
- Alpha-tocopherol (body's main form of vitamin E) functions as an antioxidant, regulates cell signaling, influences immune function and inhibits coagulation.
- Deficiency may occur with malabsorption, cholestyramine, colestipol, isoniazid, orlistat, olestra and certain anti-convulsants (e.g., phenobarbital, phenytoin).
- Deficiency may result in peripheral neuropathy, ataxia, muscle weakness, retinopathy, and increased risk of CVD, prostate cancer and cataracts.
- Food sources include oils (olive, soy, corn, canola, safflower, sunflower), eggs, nuts, seeds, spinach, carrots, avocado, dark leafy greens and wheat germ.

α-Lipoic Acid



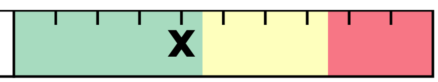
- α-Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of α-lipoic acid may improve glucose utilization and protect against diabetic neuropathy, vascular disease and age-related cognitive decline.
- Main food sources include organ meats, spinach and broccoli. Lesser sources include tomato, peas, Brussels sprouts and brewer's yeast.

CoQ10



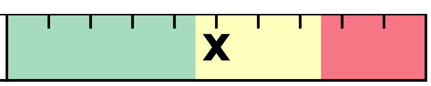
- CoQ10 is a powerful antioxidant that is synthesized in the body and contained in cell membranes. CoQ10 is also essential for energy production & pH regulation.
- CoQ10 deficiency may occur with HMG-CoA reductase inhibitors (statins), several anti-diabetic medication classes (biguanides, sulfonylureas) or beta-blockers.
- Low levels may aggravate oxidative stress, diabetes, cancer, congestive heart failure, cardiac arrhythmias, gingivitis and neurologic diseases.
- Main food sources include meat, poultry, fish, soybean, canola oil, nuts and whole grains. Moderate sources include fruits, vegetables, eggs and dairy.

Glutathione



- Glutathione (GSH) is composed of cysteine, glutamine & glycine. GSH is a source of sulfate and plays a key role in antioxidant activity and detoxification of toxins.
- GSH requirement is increased with high-fat diets, cigarette smoke, cystinuria, chronic alcoholism, chronic acetaminophen use, infection, inflammation and toxic exposure.
- Deficiency may result in oxidative stress & damage, impaired detoxification, altered immunity, macular degeneration and increased risk of chronic illness.
- Food sources of GSH precursors include meats, poultry, fish, soy, corn, nuts, seeds, wheat germ, milk and cheese.

Plant-based Antioxidants



- Oxidative stress is the imbalance between the production of free radicals and the body's ability to readily detoxify these reactive species and/or repair the resulting damage with anti-oxidants.
- Oxidative stress can be endogenous (energy production and inflammation) or exogenous (exercise, exposure to environmental toxins).
- Oxidative stress has been implicated clinically in the development of neurodegenerative diseases, cardiovascular diseases and chronic fatigue syndrome.
- Antioxidants may be found in whole food sources (e.g., brightly colored fruits & vegetables, green tea, turmeric) as well as nutraceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

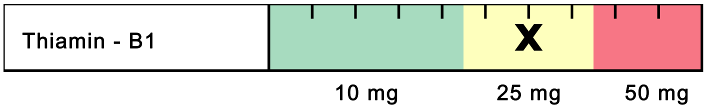
Key

- Function
- Causes of Deficiency
- Complications of Deficiency
- Food Sources

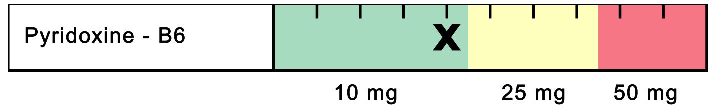
Interpretation At-A-Glance

Nutritional Needs

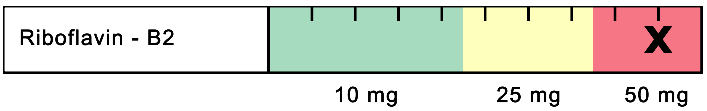
B-Vitamins



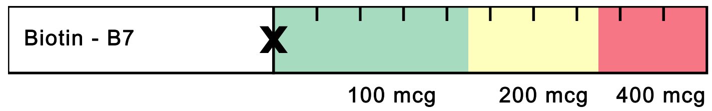
- B1 is a required cofactor for enzymes involved in energy production from food, and for the synthesis of ATP, GTP, DNA, RNA and NADPH.
- Low B1 can result from chronic alcoholism, diuretics, digoxin, oral contraceptives and HRT, or large amounts of tea & coffee (contain anti-B1 factors).
- B1 deficiency may lead to dry beriberi (e.g., neuropathy, muscle weakness), wet beriberi (e.g., cardiac problems, edema), encephalopathy or dementia.
- Food sources include lentils, whole grains, wheat germ, Brazil nuts, peas, organ meats, brewer's yeast, blackstrap molasses, spinach, milk & eggs.



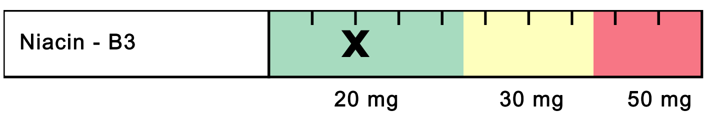
- B6 (as P5P) is a cofactor for enzymes involved in glycogenolysis & gluconeogenesis, and synthesis of neurotransmitters, heme, B3, RBCs and nucleic acids.
- Low B6 may result from chronic alcoholism, long-term diuretics, estrogens (oral contraceptives and HRT), anti-TB meds, penicillamine, L-DOPA or digoxin.
- B6 deficiency may result in neurologic symptoms (e.g., irritability, depression, seizures), oral inflammation, impaired immunity or increased homocysteine.
- Food sources include poultry, beef, beef liver, fish, whole grains, wheat germ, soybean, lentils, nuts & seeds, potato, spinach and carrots.



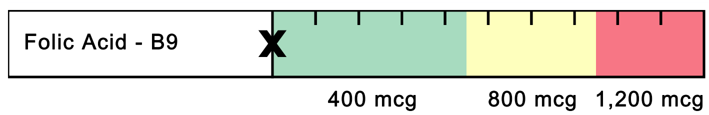
- B2 is a key component of enzymes involved in antioxidant function, energy production, detoxification, methionine metabolism and vitamin activation.
- Low B2 may result from chronic alcoholism, some anti-psychotic medications, oral contraceptives, tricyclic antidepressants, quinacrine or adriamycin.
- B2 deficiency may result in oxidative stress, mitochondrial dysfunction, low uric acid, low B3 or B6, high homocysteine, anemia or oral & throat inflammation.
- Food sources include milk, cheese, eggs, whole grains, beef, chicken, wheat germ, fish, broccoli, asparagus, spinach, mushrooms and almonds.



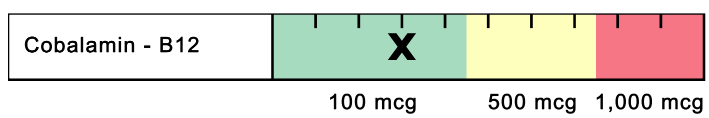
- Biotin is a cofactor for enzymes involved in functions such as fatty acid synthesis, mitochondrial FA oxidation, gluconeogenesis and DNA replication & transcription.
- Deficiency may result from certain inborn errors, chronic intake of raw egg whites, long-term TPN, anticonvulsants, high-dose B5, sulfa drugs & other antibiotics.
- Low levels may result in neurologic symptoms (e.g., paresthesias, depression), hair loss, scaly rash on face or genitals or impaired immunity.
- Food sources include yeast, whole grains, wheat germ, eggs, cheese, liver, meats, fish, wheat, nuts & seeds, avocado, raspberries, sweet potato and cauliflower.



- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid or oral contraceptive use.
- B3 deficiency may result in pellagra (dermatitis, diarrhea, dementia), neurologic symptoms (e.g., depression, memory loss), bright red tongue or fatigue.
- Food sources include poultry, beef, organ meats, fish, whole grains, peanuts, seeds, lentils, brewer's yeast and lima beans.



- Folic acid plays a key role in coenzymes involved in DNA and SAMe synthesis, methylation, nucleic acids & amino acid metabolism and RBC production.
- Low folate may result from alcoholism, high-dose NSAIDs, diabetic meds, H2 blockers, some diuretics and anti-convulsants, SSRIs, methotrexate, trimethoprim, pyrimethamine, triamterene, sulfasalazine or cholestyramine.
- Folate deficiency can result in anemia, fatigue, low methionine, increased homocysteine, impaired immunity, heart disease, birth defects and CA risk.
- Food sources include fortified grains, green vegetables, beans & legumes.



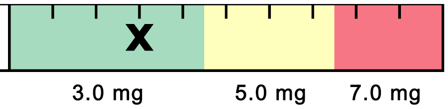
- B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 blockers, PPIs), vegan diets, diabetic meds, cholestyramine, chloramphenicol, neomycin or colchicine.
- B12 deficiency can lead to anemia, fatigue, neurologic symptoms (e.g., paresthesias, memory loss, depression, dementia), methylation defects or chromosome breaks.
- Food sources include shellfish, red meat poultry, fish, eggs, milk and cheese.

Interpretation At-A-Glance

Nutritional Needs

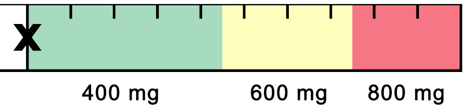
Minerals

Manganese



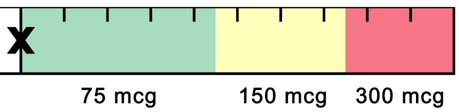
- Manganese plays an important role in antioxidant function, gluconeogenesis, the urea cycle, cartilage & bone formation, energy production and digestion.
- Impaired absorption of Mn may occur with excess intake of Fe, Ca, Cu, folic acid, or phosphorous compounds, or use of long-term TPN, Mg-containing antacids or laxatives.
- Deficiency may result in impaired bone/connective tissue growth, glucose & lipid dysregulation, infertility, oxidative stress, inflammation or hyperammonemia.
- Food sources include whole grains, legumes, dried fruits, nuts, dark green leafy vegetables, liver, kidney and tea.

Magnesium



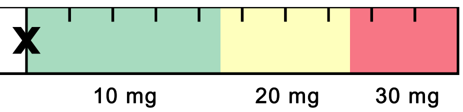
- Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses of zinc.
- Low Mg may result in muscle weakness/spasm, constipation, depression, hypertension, arrhythmias, hypocalcemia, hypokalemia or personality changes.
- Food sources include dark leafy greens, oatmeal, buckwheat, unpolished grains, chocolate, milk, nuts & seeds, lima beans and molasses.

Molybdenum



- Molybdenum is a cofactor for enzymes that convert sulfites to sulfate, and nucleotides to uric acid, and that help metabolize aldehydes & other toxins.
- Low Mo levels may result from long-term TPN that does not include Mo.
- Mo deficiency may result in increased sulfite, decreased plasma uric acid (and antioxidant function), deficient sulfate, impaired sulfation (detoxification), neurologic disorders or brain damage (if severe deficiency).
- Food sources include buckwheat, beans, grains, nuts, beans, lentils, meats and vegetables (although Mo content of plants depends on soil content).

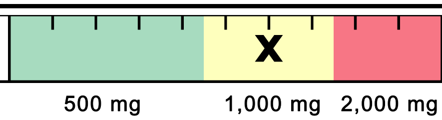
Zinc



- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency can result in hair loss and skin rashes, also impairments in growth & healing, immunity, sexual function, taste & smell and digestion.
- Food sources include oysters, organ meats, soybean, wheat germ, seeds, nuts, red meat, chicken, herring, milk, yeast, leafy and root vegetables.

Essential Fatty Acids

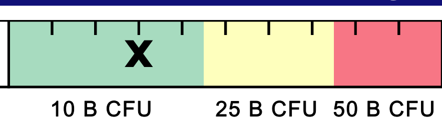
Need for Essential Fatty Acids



- Omega-3 (O3) and Omega-6 (O6) fatty acids are polyunsaturated fatty acids that cannot be synthesized by the human body. They are classified as essential nutrients and must be obtained from dietary sources.
- The standard American diet is much higher in O6 than O3 fatty acids. Deficiency of EFAs may result from poor dietary intake and/or poor conversion from food sources.
- EFA deficiency is associated with decreased growth & development of infants and children, dry skin/rash, poor wound healing, and increased risk of infection, cardiovascular and inflammatory diseases.
- Dietary sources of the O6 Linoleic Acid (LA) include vegetable oils, nuts, seeds and some vegetables. Dietary sources of the O3 a-Linolenic Acid (ALA) include flaxseeds, walnuts, and their oils. Fish (mackerel, salmon, sardines) are the major dietary sources of the O3 fatty acids EPA and DHA.

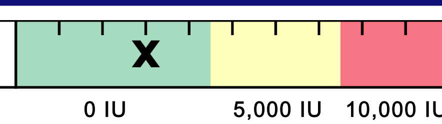
Digestive Support

Need for Probiotics



- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhance digestion & absorption; decrease severity of diarrheal illness; modulate of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section delivery, antibiotic use, improved sanitation, decreased consumption of fermented foods and use of certain drugs.
- Some of the diseases associated with microflora imbalances include: IBS, IBD, fibromyalgia, chronic fatigue syndrome, obesity, atopic illness, colic and cancer.
- Food sources rich in probiotics are yogurt, kefir and fermented foods.

Need for Pancreatic Enzymes



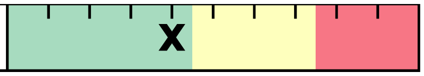
- Pancreatic enzymes are secreted by the exocrine glands of the pancreas and include protease/peptidase, lipase and amylase.
- Pancreatic exocrine insufficiency may be primary or secondary in nature. Any indication of insufficiency warrants further evaluation for underlying cause (i.e., celiac disease, small intestine villous atrophy, small bowel bacterial overgrowth).
- A high functional need for digestive enzymes suggests that there is an impairment related to digestive capacity.
- Determining the strength of the pancreatic enzyme support depends on the degree of functional impairment. Supplement potency is based on the lipase units present in both prescriptive and non-prescriptive agents.

NutrEval® Plasma amino acids

Interpretation At-A-Glance

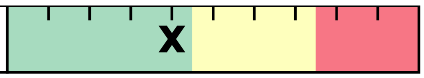
Functional Imbalances

Mitochondrial Dysfunction



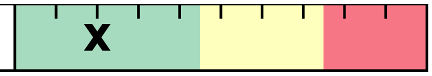
- Mitochondria are a primary site of generation of reactive oxygen species. Oxidative damage is considered an important factor in decline of physiologic function that occurs with aging and stress.
- Mitochondrial defects have been identified in cardiovascular disease, fatigue syndromes, neurologic disorders such as Parkinson's and Alzheimer's disease, as well as a variety of genetic conditions. Common nutritional deficiencies can impair mitochondrial efficiency.

Toxic Exposure



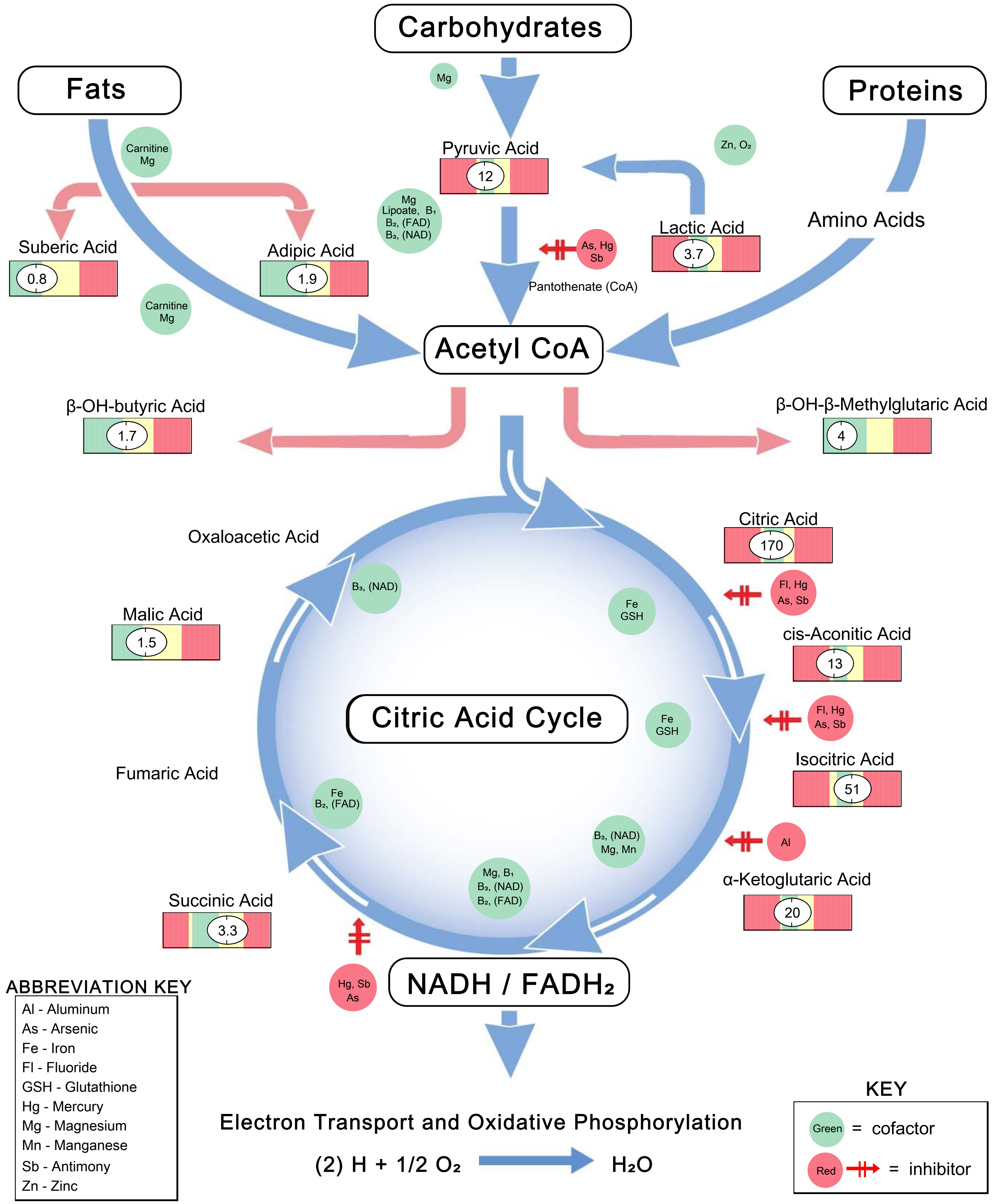
- Methyl tert-Butyl Ether (MTBE) is a common gasoline additive used to increase octane ratings, and has been found to contaminate ground water supplies where gasoline is stored. Inhalation of MTBE may cause nose and throat irritation, as well as headaches, nausea, dizziness and mental confusion. Animal studies suggest that drinking MTBE may cause gastrointestinal irritation, liver and kidney damage and nervous system effects.
- Styrene is classified by the US EPA as a "potential human carcinogen," and is found widely distributed in commercial products such as rubber, plastic, insulation, fiberglass, pipes, food containers and carpet backing.
- Levels of these toxic substances should be examined within the context of the body's functional capacity for methylation and need for glutathione.

Need for Methylation



- Methylation is an enzymatic process that is critical for both synthesis and inactivation. DNA, estrogen and neurotransmitter metabolism are all dependent on appropriate methylation activity.
- B vitamins and other nutrients (methionine, magnesium, selenium) functionally support catechol-O-methyltransferase (COMT), the enzyme responsible for methylation.

Krebs Cycle At-A-Glance



ABBREVIATION KEY

- Al - Aluminum
- As - Arsenic
- Fe - Iron
- Fl - Fluoride
- GSH - Glutathione
- Hg - Mercury
- Mg - Magnesium
- Mn - Manganese
- Sb - Antimony
- Zn - Zinc

All biomarkers reported in mmol/mol creatinine unless otherwise noted.

Metabolic Analysis Markers (Urine)

Malabsorption and Dysbiosis Markers

Malabsorption Markers

		Reference Range
Indoleacetic Acid (IAA)	1.1	<= 4.2
Phenylacetic Acid (PAA)	0.09	<= 0.12

Bacterial Dysbiosis Markers

Dihydroxyphenylpropionic Acid (DHPPA)	1.3	<= 5.3
3-Hydroxyphenylacetic Acid	2.7	<= 8.1
4-Hydroxyphenylacetic Acid	9	<= 29
Benzoic Acid	0.07	<= 0.05
Hippuric Acid	99	<= 603

Yeast / Fungal Dysbiosis Markers

Arabinose	40	<= 96
Citramalic Acid	3.7	<= 5.8
Tartaric Acid	9	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism

		Reference Range
Lactic Acid	3.7	1.9-19.8
Pyruvic Acid	12	7-32
β-OH-Butyric Acid (BHBA)	1.7	<= 2.8

Energy Metabolism

Citric Acid	170	40-520
Cis-Aconitic Acid	13	10-36
Isocitric Acid	51	22-65
α-Ketoglutaric Acid (AKG)	20	4-52
Succinic Acid	3.3	0.4-4.6
Malic Acid	1.5	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	4	<= 15

Fatty Acid Metabolism

Adipic Acid	1.9	<= 2.8
Suberic Acid	0.8	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	14.3	3.1-19.5 mmol/L

Methodology: GCMS, LC/MS/MS, Alkaline Picrate

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	1.5	0.4-3.6
Homovanillic Acid	2.5	1.2-5.3
5-OH-indoleacetic Acid	11.4	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.08	0.02-0.22
Kynurenic Acid	2.4	<= 7.1
Quinolinic Acid	3.3	<= 9.1
Kynurenic / Quinolinic Ratio	0.73	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.7	<= 1.7
α-Ketoisovaleric Acid	0.51	<= 0.97
α-Ketoisocaproic Acid	0.51	<= 0.89
α-Keto-β-Methylvaleric Acid	1.7	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.6	<= 1.5
Glutaric Acid	0.55	<= 0.51
Isovalerylglycine	2.8	<= 3.7
Methylmalonic Acid	0.5	<= 1.9
Xanthurenic Acid	0.26	<= 0.96
3-Hydroxypropionic Acid	8	5-22
3-Hydroxyisovaleric Acid	14	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.22	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	5.4	<= 6.7
Orotic Acid	0.53	0.33-1.01
Pyroglutamic Acid	22	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	7	<= 19
2-Hydroxyphenylacetic Acid	0.49	<= 0.76

Metabolic Analysis Reference Ranges are Age Specific

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ◆, the assay has not been cleared by the U.S. Food and Drug Administration.

Amino Acids (Plasma)

All biomarkers reported in micromoles per deciliter unless stated otherwise.

Nutritionally Essential Amino Acids

Amino Acid		Reference Range
Arginine	4.4	6.0-17.5
Histidine	7.7	6.5-13.3
Isoleucine	6.54	5.79-18.69
Leucine	12.0	12.1-36.1
Lysine	17.3	13.7-34.7
Methionine	3.2	2.3-6.5
Phenylalanine	7.32	6.07-17.46
Taurine	5.26	4.41-10.99
Threonine	9.00	6.42-16.32
Tryptophan	4.46	2.65-6.67
Valine	16.8	18.3-42.6

Nonessential Protein Amino Acids

Amino Acid		Reference Range
Alanine	25	23-62
Asparagine	5.3	3.5-11.6
Aspartic Acid	<DL	<= 0.67
Cyst(e)ine	5.9	5.9-19.9
γ-Aminobutyric Acid	0.05	<= 0.06
Glutamic Acid	4.6	2.0-14.5
Glutamine	53	44-111
Proline	26	15-57
Tyrosine	6.5	6.2-18.5

Intermediary Metabolites

B Vitamin Markers

B Vitamin Markers		Reference Range
α-Aminoadipic Acid	0.12	<= 0.28
α-Amino-N-butyric Acid	3.00	1.76-9.99
β-Aminoisobutyric Acid	0.17	<= 0.72
Cystathionine	0.04	<= 0.09
3-Methylhistidine	0.28	<= 0.78

Urea Cycle Markers

Urea Cycle Markers		
Citrulline	1.8	1.6-5.7
Ornithine	8.26	4.38-15.42
Urea	341	216-1,156

Glycine/Serine Metabolites

Glycine/Serine Metabolites		
Glycine	14	5-23
Serine	5.5	2.1-7.0
Ethanolamine	0.31	0.19-0.78
Phosphoethanolamine	0.26	0.15-0.64
Phosphoserine	<DL	<= 0.39
Sarcosine	0.05	<= 0.15

Dietary Peptide Related Markers

		Reference Range
1-Methylhistidine	0.31	<= 1.64
β-Alanine	0.3	<= 0.7

Methodology: LC/MS/MS

Amino Acid Reference Ranges are age specific.

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Assays have not been cleared by the U.S. Food and Drug Administration.

Essential and Metabolic Fatty Acids Markers (RBCs)

Omega 3 Fatty Acids

Analyte	(cold water fish, flax, walnut)	Reference Range
α-Linolenic (ALA) 18:3 n3	0.19	>= 0.09 wt %
Eicosapentaenoic (EPA) 20:5 n3	0.35	>= 0.16 wt %
Docosapentaenoic (DPA) 22:5 n3	1.79	>= 1.14 wt %
Docosahexaenoic (DHA) 22:6 n3	2.7	>= 2.1 wt %
% Omega 3s	5.0	>= 3.8

Omega 9 Fatty Acids

Analyte	(olive oil)	Reference Range
Oleic 18:1 n9	11	10-13 wt %
Nervonic 24:1 n9	3.1	2.1-3.5 wt %
% Omega 9s	14.7	13.3-16.6

Saturated Fatty Acids

Analyte	(meat, dairy, coconuts, palm oils)	Reference Range
Palmitic C16:0	20	18-23 wt %
Stearic C18:0	17	14-17 wt %
Arachidic C20:0	0.28	0.22-0.35 wt %
Behenic C22:0	1.07	0.92-1.68 wt %
Tricosanoic C23:0	0.29	0.12-0.18 wt %
Lignoceric C24:0	2.8	2.1-3.8 wt %
Pentadecanoic C15:0	0.12	0.07-0.15 wt %
Margaric C17:0	0.31	0.22-0.37 wt %
% Saturated Fats	41.9	39.8-43.6

Methodology: GCMS

Omega 6 Fatty Acids

Analyte	(vegetable oil, grains, most meats, dairy)	Reference Range
Linoleic (LA) 18:2 n6	15.4	10.5-16.9 wt %
γ-Linolenic (GLA) 18:3 n6	0.09	0.03-0.13 wt %
Dihomo-γ-linolenic (DGLA) 20:3 n6	1.77	>= 1.19 wt %
Arachidonic (AA) 20:4 n6	16	15-21 wt %
Docosatetraenoic (DTA) 22:4 n6	2.99	1.50-4.20 wt %
Eicosadienoic 20:2 n6	0.33	<= 0.26 wt %
% Omega 6s	36.6	30.5-39.7

Monounsaturated Fats

Omega 7 Fats		Reference Range
Palmitoleic 16:1 n7	0.23	<= 0.64 wt %
Vaccenic 18:1 n7	0.94	<= 1.13 wt %

Trans Fat		
Elaidic 18:1 n9t	0.47	<= 0.59 wt %

Delta - 6 Desaturase Activity

	Upregulated / Functional / Impaired	
Linoleic / DGLA 18:2 n6 / 20:3 n6	8.7	6.0-12.3

Cardiovascular Risk

Analyte		Reference Range
Omega 6s / Omega 3s	7.3	3.4-10.7
AA / EPA 20:4 n6 / 20:5 n3	45	12-125
Omega 3 Index	3.1	>= 4.0

The Essential Fatty Acid reference ranges are based on an adult population.

Essential Fatty Acid Metabolism

Omega 3 Family

α-Linolenic Acid
flax, walnut, grasses
0.19

Stearidonic acid

Eicosatetraenoic acid, ETA

Eicosapentaenoic Acid
cold water fish
0.35
→ Anti-inflammatory Eicosanoids

Docosapentaenoic Acid
1.79

Docosahexaenoic Acid
cold water fish
2.7

Omega 6 Family

Linoleic Acid
grains, vegetable oils
15.4

γ-Linolenic Acid
evening primrose, borage, black currant
0.09

Dihomo-γ-Linolenic Acid
1.77
→ Series 1 Prostaglandins Anti-inflammatory

Arachidonic Acid
animal fats
16
→ Pro-inflammatory Eicosanoids

Docosatetraenoic Acid
2.99

Enzymes

Delta-6 Desaturase
Vitamin and Mineral Cofactors:

FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:

Niacin (B3)
Pyridoxal-5-phosphate (B6)
Pantothenic Acid (B5)
Biotin, Vitamin C

Delta-5 Desaturase
Vitamin and Mineral Cofactors:

FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:

Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Pantothenic Acid (B5), Vitamin C

Elongase
Delta-6 Desaturase
Vitamin and Mineral Cofactors:

FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Vitamin C, Zn, Mg, Carnitine
Pantothenic Acid (B5)

This test was developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared by the U.S. Food and Drug Administration.

Oxidative Stress Markers

Oxidative Stress Markers

Methodology: Colorimetric, thiobarbituric acid reactive substances (TBARS), Alkaline Picrate, Hexokinase/G-6-PDH, LC/MS/MS, HPLC

	Result	Reference Range
Glutathione (whole blood)	1,353	>=669 micromol/L
Lipid Peroxides (urine)	7.6	<=10.0 micromol/g Creat.
8-OHdG (urine)	7	<=15 mcg/g Creat.
Coenzyme Q10, Ubiquinone (serum)	0.59	0.43-1.49 mcg/mL

The Oxidative Stress reference ranges are based on an adult population.

The performance characteristics of the Oxidative Stress Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Vitamin D (Serum)

Methodology: Chemiluminescent

	Inside Range	Outside Range	Reference Range
25 - OH Vitamin D ◆		21	50-100 ng/mL

Deficiency = < 20 ng/mL (< 50 nmol/L)
Insufficiency = 20-49 ng/mL (50-124 nmol/L)
Optimal = 50-100 ng/mL (125-250 nmol/L)
Excessive = > 100 ng/mL (> 250 nmol/L)

Elemental Markers

Nutrient Elements

Element	Reference Range	Reference Range
Copper *(plasma)*	138.0	75.3-192.0 mcg/dL
Magnesium *(RBC)*	46.2	30.1-56.5 mcg/g
Manganese *(whole blood)*	7.9	3.0-16.5 mcg/L
Potassium *(RBC)*	3,045	2,220-3,626 mcg/g
Selenium *(whole blood)*	187	109-330 mcg/L
Zinc *(plasma)*	134.3	64.3-159.4 mcg/dL

Toxic Elements*

Element	Reference Range	Reference Range
Lead	0.82	<= 2.81 mcg/dL
Mercury	<DL	<= 4.35 mcg/L
Arsenic	5.0	<= 13.7 mcg/L
Cadmium	1.22	<= 1.22 mcg/L
Tin	<DL	<= 0.39 mcg/L

* All toxic Elements are measured in whole blood.

Methodology: ICP-MS

The Elemental reference ranges are based on an adult population.

The performance characteristics of the Elemental Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Elemental testing performed by Genova Diagnostics, Inc. 3425 Corporate Way, Duluth, GA 30096 - Robert M. David, PhD, Lab Director - CLIA Lic. #11D0255349 - Medicare Lic. #34-8475

Commentary

Please note the reference range for 8-OHdG (urine) has been updated.

Interpretation At-A-Glance Details

Antioxidants

Vitamin A / Carotenoids	**Contributing Biomarkers:** Lipid Peroxides
Vitamin E / Tocopherols	**Contributing Biomarkers:** Lipid Peroxides
α-Lipoic Acid	**Contributing Biomarkers:** Lipid Peroxides Taurine
CoQ10	**Contributing Biomarkers:** Succinic Acid
Glutathione	**Contributing Biomarkers:** Lipid Peroxides
Plant-based Antioxidants	**Contributing Biomarkers:** Lipid Peroxides

B-Vitamins

Thiamin - B1	**Contributing Biomarkers:** 5-OH-Indoleacetic Acid α-Keto-β-Methylvaleric Acid α-Ketoisovaleric Acid
Riboflavin - B2	**Contributing Biomarkers:** Glutaric Acid
Niacin - B3	**Contributing Biomarkers:** Leucine Valine

Interpretation At-A-Glance Details

Pyridoxine - B6	Contributing Biomarkers: Arginine Cyst(e)ine Leucine Valine
Cobalamin - B12	Contributing Biomarkers: Cyst(e)ine Leucine

Minerals

Manganese	Contributing Biomarkers: 5-OH-Indoleacetic Acid

Essential Fatty Acids

Need for Essential Fatty Acids	Contributing Biomarkers: Omega 3 Index

Digestive Support

Need for Probiotics	Contributing Biomarkers: Benzoic Acid
Need for Pancreatic Enzymes	Contributing Biomarkers: Leucine Valine

Interpretation At-A-Glance Details

Functional Imbalances

Mitochondrial Dysfunction	**Contributing Biomarkers:** Glutaric Acid
Need for Methylation	**Contributing Biomarkers:** Arginine
Toxic Exposure	**Contributing Biomarkers:** Glutaric Acid

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

Benzoic acid is a common food component, especially in fruits and in particular berries/cranberries. It is also a common food additive/preservative. Benzoic acid is also formed by gut microflora metabolism of phenylalanine and dietary polyphenols. Elevated levels may thus reflect dietary intake (for example strawberries), imbalanced gut flora or a high intake of polyphenols or phenylalanine. Older studies note a relationship between decreased cognitive function and increased BA in the urine.

Glutaric Acid is measured to be high. This organic acid is formed from the essential amino acids lysine (primarily) and tryptophan, via alpha ketoadipic acid (AKAA) and glutaryl-CoA. Glutaric acid is elevated when glutaryl CoA metabolism is impaired, such as when needed nutrient cofactors are missing. Glutaryl-CoA is dehydrogenated to form glutaconyl-CoA and then crotonyl-CoA using a FAD-dependent dehydrogenase enzyme; the FAD (from riboflavin) becomes FADH2.

Glutaric aciduria may have negligible manifestations if mild, but if the dehydrogenase is notably weak, then severe symptoms can be experienced beginning in infancy and childhood with general neurological deterioration, spasticity and mental retardation. Glutaric acid can be very elevated in the rare case of multiple acyl-CoA dehydrogenase dysfunction. The resulting glutaric aciduria type II can lead to metabolic acidosis, hypoglycemia, hypotonia, nausea and diarrhea, and frequently the individual has a "sweaty feet" or foul odor. Poor weight gain and frequent regurgitation of food are seen in children. In glutaric aciduria type II, adipic, lactic, and beta-hydroxybutyric (BHBA) acids are also elevated. This more general enzyme impairment is postulated to be a weakness in mitochondrial electron transfer. Glutaric acid excess may or may not be helped by supplementation of riboflavin, mitochondrial support nutrients, or CoQ10.

Amino Acid Markers (Plasma)

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

Arginine is low in the plasma. This amino acid is semiessential; it participates in the urea cycle for detoxication of ammonia, and it is a component of body protein. Arginine is a precursor of creatine and creatinine which are involved in muscle metabolism. Release of insulin by the pancreas is stimulated by arginine, and transient hyper-, hypoglycemia can be a consequence of arginine deficiency. Additionally, arginine is very important to leukocytes and immune function and is documented to stimulate killer cell activity for phagocytosis. Subnormal arginine often is consistent with muscle weakness, fatigue and is occasionally coincident with chronic infections. Arginine is found in all protein foods and is very abundant in seeds and nuts. Deficient arginine uptake can result from a poor quality diet or from gastrointestinal dysfunction. Rarely, low blood arginine can be secondary to renal wasting in cystinuria. A 24-hour urine amino acid analysis would rule out or confirm this possibility.

Leucine is measured to be low. It is nutritionally essential and is required for formation of body proteins, enzymes and some hormones. Leucine itself has a hormone-like activity which is stimulation of pancreatic release of insulin. The branched-chain structure of leucine makes it very important for the formation of flexible collagen tissues, particularly elastin in ligaments. Leucine is relatively abundant in all protein foods. Subnormal leucine is unusual but can coincide with: deficient activity of digestive peptidases, zinc deficiency, pancreatic dysfunction, or poor quality diet. Food intolerances and malabsorption may be coincident with subnormal leucine. This branched-chain amino acid often is subnormal in hepatic encephalopathy, and absorption and uptake can also be deficient following intestinal bypass procedures.

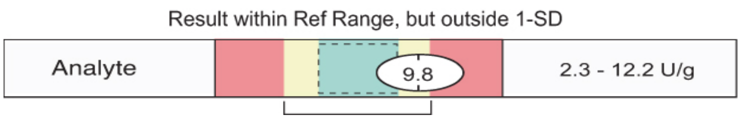
Valine, a branched-chain structured amino acid, is measured to be low. This nutritionally essential amino acid is required for formation of body proteins and enzymes and it is normally in physiological balance with the other two similarly structured amino acids, leucine and isoleucine. The branched-chain structure of valine makes it very important to the formation of flexible collagen tissues, such as elastin in ligaments. Valine is relatively abundant in all protein foods. Low valine may result from a poor quality diet or from gastrointestinal dysfunction, particularly from digestive peptidase dysfunction. Zinc deficiency, pancreatic insufficiency, acidic small intestine, food intolerances and malabsorption may be involved. This branched-chain amino acid often is subnormal in hepatic encephalopathy, and absorption and uptake can also be deficient following intestinal bypass procedures.

Essential & Metabolic Fatty Acids Markers (RBCs)

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The **Reference Range** is a statistical interval representing 95% or 2 Standard Deviations (2 S.D.) of the reference population. One Standard Deviation (1 S.D.) is a statistical interval representing 68% of the reference population. Values between 1 and 2 S.D. are not necessarily abnormal. Clinical correlation is suggested. (See example below)



Fatty Acids and Your Health

Doctors and nutritionists used to think that all fat was merely a way for the body to store calories for later use as energy, since, as we all know too well, if we eat excess food, our body converts those calories to fat. Only in the last century have we discovered that some fats are absolutely essential to health. Our bodies cannot make these fats, and so we must get them from our food, or our health will suffer. These Essential Fatty Acids (EFAs) have many functions in the body: they are the precursors for local "hormones"; they regulate all inflammation as well as all smooth muscle contraction and relaxation. These local hormones are given names like prostaglandins, leukotrienes and thromboxanes. EFAs are also essential components for all cell membranes. Their importance for health cannot be overemphasized since the brain, nerves, eyes, connective tissue, skin, blood vessels, and every cell in the body depend on a proper balance of essential fatty acids for optimal function. It is the fats found in red blood cell membranes, known as phospholipids, that this test measures.

Essential fatty acids are classified into fat "families": omega 3 fats and omega 6 fats. Non-essential fat "families" include omega-9 fats, saturated fats, omega-7 fats, and trans-fats. Optimal health depends on the proper balance of all fats - both essential and non-essential fats - in the diet. Proper balance means adequate amounts of each individual fat, without having too much, and maintaining proper balance between the various "families" of fats. Fat health also means avoiding potentially harmful fats such as trans fats found in shortening, margarine, fried foods and dairy. A proper balance of fatty acids will lead to mental health and proper nerve function, a healthy heart and circulatory system, reduced inflammation in general, proper gastrointestinal and lung function, a more balanced immune system, and even healthy skin, hair and nails. Fatty acid balance is also critical for the health of all pregnant women and their babies since the developing brain and nervous system of the baby requires large amounts of EFAs that must come from the mother. Fatty acid imbalances have been seen in many disease processes including heart disease, hypertension, insulin resistance and diabetes, asthma, painful menstruation, pre-menstrual syndrome (PMS), depression, attention deficit hyperactivity disorder (ADHD), senility, obsessive-compulsive disorder, and post-partum depression.

This Essential and Metabolic Fatty Acid Analysis allows your health care practitioner to examine the fats found in your red blood cell membranes. These fats represent the types of fats your body has available to make cell membranes and the local "hormones" that control inflammation and smooth muscle contraction throughout the body. Following your health care practitioner's advice on diet and fatty acid supplementation is likely to restore your fatty acids to a state of healthy balance.

Results of Your Individual Essential and Metabolic Fatty Acid Analysis

Docosahexaenoic acid (DHA) is within the reference range, but below the functional physiologic range. DHA is the

Commentary

longest and most polyunsaturated fatty acid in the body and is critical for proper membrane fluidity and for the proper function of all cells, especially nerve and brain. Low DHA (and low ALA, and the ratio of AA to EPA) has been correlated with the severity of depression in depressed patients. Low DHA has also been associated with increased tendency to aggression, violence, depression and suicide.

Adequate DHA is critical for pregnant or breast-feeding women and their babies. Brain and nerve cells in the developing fetus require huge amounts of DHA (and AA). The brain at birth weighs ~350g and by 12 months old weighs ~1000g. 60% of the brain├s weight is fat, the most important being DHA and AA. Because these fats are essential, they must come from the mother. Women with lower DHA levels have a much higher incidence of gestational diabetes, hypertension and pre-eclampsia during pregnancy and a much higher incidence of post-partum depression and post-partum obsessive/compulsive disorder after birth. Breast fed babies show much faster neurological development, presumably due to the presence of DHA and AA in breast milk. Until very recently, baby formula did not contain DHA or AA. Moderate maternal DHA supplementation has been shown to increase breast milk DHA levels dramatically.

DHA is found in cold water fish (salmon, mackerel, sardines, etc.) and in fish oil and cod liver oil supplements. A vegetarian, algae-derived DHA is available as a supplement.

Linoleic acid (LA) is within the reference range, but above the functional physiologic range. LA is the main fatty acid in all vegetable oils (corn, peanut, soy, sunflower, safflower, canola, etc.). High LA levels are frequently seen in people consuming a high fat diet, especially with over-consumption of vegetable oils. High LA consumption has been associated with increased risk of breast, colon and prostate cancers; and with increased risk of cognitive impairment. LA is known to be a cellular mitogen; adequate amounts facilitate cell repair and division, but excess amounts may lead to abnormal cell division.

Reducing the consumption of vegetable oils and using olive oil (high in omega-9 oleic acid) as the main dietary oil is the best means of lowering LA levels.

Elaidic acid is within the reference range, but above the functional physiologic range. Elaidic acid is a trans fatty acid and may represent excess consumption of partially hydrogenated oils (shortening, margarine, fried foods, etc.) or dairy fat (cream, ice cream, whole milk, etc.). Because of their shape, trans fats behave like saturated fats and have been shown to increase LDL cholesterol levels and decrease HDL cholesterol levels, contributing to the development of heart disease. The double bond in trans fats is thought to bind to desaturase enzymes and impair the production of their metabolically necessary products. Epidemiological studies have associated increased trans fat consumption with breast, colon and prostate cancer incidence.

Pentadecanoic acid and/or Tricosanoic acid are above the reference range. Odd chain fatty acids are produced when endogenous fatty acid synthesis begins with propionic acid (3-carbon fatty acid) as substrate rather than acetic acid (2-carbon). Propionate is found in high quantities in butter and other dairy products. Propionate is also one of the short chain fatty acids produced by our gut bacteria in the fermentation (digestion) of water-soluble fiber. With adequate B12 and biotin, propionate can be converted into succinate for use in the citric acid cycle and energy production. High levels of odd chain fatty acids in cell membranes may indicate an increased need for B12 and biotin, or may result from an exceptionally high water-soluble fiber diet.

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The performance characteristics of this assay have been verified by Genova Diagnostics, Inc. This assay for Vitamin D has been cleared by the U.S. Food and Drug Administration.

Deficient or Insufficient levels:

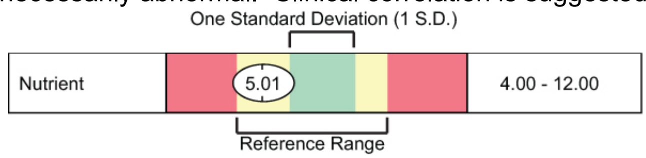
Vitamin D is a hormone produced in the skin during exposure to sunlight or consumed in the diet, and converted to its active form, calcitriol, in the liver and kidneys. Vitamin D helps regulate serum calcium and phosphorus levels by increasing intestinal absorption of calcium and stimulating tubular reabsorption of calcium. Vitamin D also affects numerous other functions in the body.

Calcitriol deficiency can result in rickets or osteomalacia due to under-mineralization of the growing skeleton or demineralization of the adult skeleton, respectively. Hypovitaminosis D also increases the risk of infection, cancer, autoimmune disease, hypertension, arteriosclerosis, diabetes and/or insulin resistance, musculoskeletal pain, epilepsy, and migraine.

Commentary

Testing Methodology: ICP-MS

The **Reference Range** is a statistical interval representing 95% or 2 Standard Deviations (2 S.D.) of the reference population. One Standard Deviation (1 S.D.) is a statistical interval representing 68% of the reference population. Values between 1 and 2 S.D. are not necessarily abnormal. Clinical correlation is suggested. (See example below)



The reference range for Lead is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf

The reference range for Cadmium is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf

The reference range for Mercury is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf