THE INSTITUTE OF NUTRITIONAL ENDOCRINOLOGY®

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Nutrigenomics

Energy Metabolism & Mitochondria

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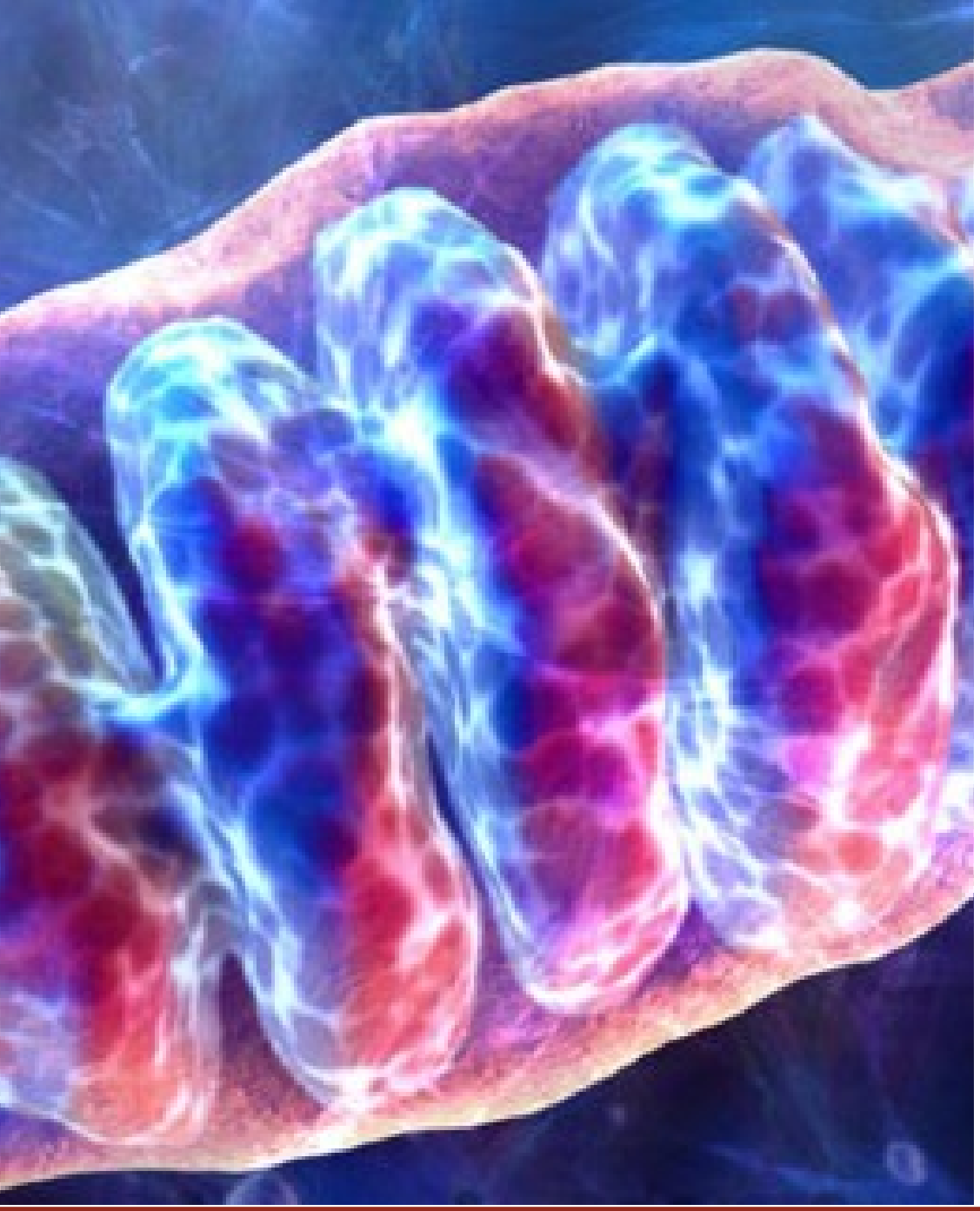
Metabolism Refers To All The Physical And Chemical Processes In The Body That Convert Or Use Energy

- Breathing
- Circulating blood
- Controlling body temperature
- Contracting muscles
- Digesting food and nutrients
- Eliminating waste through urine and feces
- Functioning of the brain and nerves

The Major Body Parts Involved in Energy Metabolism

Insulin and blood sugar management	Mitochondria	Lungs
Digestion	Thyroid/ Adrenals	Liver



Mitochondria and Energy SNPs

- ✓ **ATP5G3** - ATP synthesis.
- ✓ **COX5A** — Transfers electrons from cytochrome C to oxygen in the respiratory chain.
- ✓ **NDUFS3** (NADH dehydrogenase) — Involved in the electron transport chain. NADH transferring of electrons to CoQ10

True Report

Mitochondrial Genetics

Mitochondrial genetics analyzes various genes related to mitochondrial function. It is believed that mitochondrial genetics evolved differently than nuclear genetics. The mitochondria are the "energy-burning furnaces" in our cells. Our Mitochondria generate biological energy (ATP) from nutrients, and use critical antioxidants to protect from excess free radicals and toxicity.

RS#	Call	Risk Allele	Gene	Variation	Result
rs11648723	GG	T	UQCRC2		-/-
rs4850	GG	A	UQCRC2		-/-
rs1051806	CC	T	NDUFS8		-/-
rs2075626	TT	C	NDUFS8		-/-
rs999571	GG	A	NDUFS8		-/-
rs4147730	GG	A	NDUFS3		-/-
rs4626565	TT	C	COX6C		-/-
rs8042694	AA	G	COX5A		-/-
rs1244414	CT	T	ATP5c1		+/-
rs36089250	TT	C	ATP5g3		-/-
rs809359	AA	G	NDUFS7		-/-
rs7258846	GT	T	NDUFS7		+/-
rs1142530	CT	T	NDUFS7		+/-
rs2332496	GG	A	NDUFS7		-/-

Mitochondrial SNPs

ATP5G3 (ATP synthase, H+ transporting mitochondrial Fo complex) - ATP synthesis. Mutations may be seen in urea cycle dysfunction.

ATP5C1 (ATP synthase, H+ transporting mitochondrial F1 complex) - ATP synthesis. Mutations may be seen in Huntington's disease.

COX5A (Cytrochrome C oxidase 5A) — Transfers electrons from cytochrome C to oxygen in the respiratory chain.

COX6C (Cytochrome C oxidase 6C) — Transfers electrons from cytochrome C to oxygen in the respiratory chain.

NDUFS3 (NADH dehydrogenase) — Involved in the electron transport chain. NADH transferring of electrons to CoQ10.

NDUFS7 (NADH dehydrogenase) — Involved in the mitochondrial electron transport chain. Involved in the transference of electrons from NADH to CoQ10.

NDUFS8 (NADH dehydrogenase) — Involved in the electron transport chain. NADH transferring of electrons to CoQ10.

UQCRC2 (Ubiquinol cytochrome C reductase core) — CoQ10 cytochrome C assembly system in the respiratory chain of the mitochondria

Energy Metabolism SNPs

Gene & Variation	rsID	Risk Allele	Function	Health Risks	Actions to Take to Protect: Avoid/Reduce These: Xeno-Estrogens *	Caffeine	Alcohol	Exposure to cigarette smoke	Exposure to gas fumes	Acid-blocking Rx	Tylenol & other Rx	Char-broiled meat	Processed meats	Sugar	Processed Foods	Cosmetics and cleaners	Pesticides	Heated & oxidized fats	Increase These: Exercise and Sweat	Hydration	Phase1 enhancing foods**	Omega 3 fats	Antioxidant intake	Foods that enhance Phase 1	Green Leafy Veggies	Sulfur-rich foods/MSM	Cruciferous vegetables	Mindfulness practices	Glutathione precursors	Glucoraphanin/Sulforaphane	Milk Thistle/Liver Support	Iron if deficient	Selenium	B vitamin intake	Folate (Vitamin B9)	Vitamin B12	Vitamin A	Vitamin C	Vitamin D	Vitamin E	Lab Testing: CBC	Vitamin D	Homocysteine	Hemoglobin A1c	Blood Spot Fatty Acid	DUTCH Test	Organic Acids	Stool Analysis	Advanced Lipid
ADRB2	many		• Encodes the β2-adrenergic receptor. •Reduces epinephrine signaling	• Chronic Pain • Chronic fatigue syndrome • Obesity • Anxiety and Depression	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓					✓		✓	✓		
ADRA1A	rs2229125	C	•Binds to epinephrine (adrenaline) and norepinephrine (noradrenaline) –	• Increased susceptibility to fatigue	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓					✓		✓	✓		
CRHR1	many		• Codes a receptor that activates the HPA Axis and produces stress hormones.	• Fatigue • Depression • PTSD • IBS • Anxiety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓					✓		✓	✓		
NR3C1	rs10482665	G	• Codes for glucocorticoid receptor. • Involved in inflammatory responses, cellular proliferation, and differentiation in target tissues	• Fatigue • Hypoglycemia • Hypertension • Depression • Anxiety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓					✓		✓	✓		

Mitochondrial SNPs

Gene & Variation	rsID	Risk Allele	Function	Health Risks	Actions to Take to Protect: Avoid/Reduce These: Xeno-Estrogens*	Caffeine	Alcohol	Exposure to cigarette smoke	Exposure to gas fumes	Acid-blocking Rx	Tylenol & other Rx	Char-broiled meat	Processed meats	Sugar	Processed Foods	Cosmetics and cleaners	Pesticides	Heated & oxidized fats	Increase These: Exercise and Sweat	Hydration	Phase1 enhancing foods**	Omega 3 fats	Antioxidant intake	Foods that enhance Phase 1	Green Leafy Veggies	Sulfur-rich foods/MSM	Cruciferous vegetables	Mindfullness practices	Glutathione precursors	Glucoraphanin/Sulforapjane	Milk Thistle/Liver Support	Iron if deficient	Selenium	B vitamin intake	Folate (Vitamin B9)	Vitamin B12	Vitamin A	Vitamin C	Vitamin D	Vitamin E	Lab Testing: CBC	Vitamin D	Homocysteine	Hemoglobin A1c	Blood Spot Fatty Acid	DUTCH Test	Organic Acids	Stool Analysis
UQCRC2	rs11648723 rs4850	T A	•CoQ10 cytochrome C assembly system in the respiratory chain of the mitochondria	• Fatigue • CoQ19 deficiency symptoms- seizures, poor muscle tone, spasticity, nystagmus, vision loss, hearing loss	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔		✔						✔			✔	
NDUFS8	rs1051806 rs2075626 rs999571	T C A	•Involved in the electron transport chain. NADH transferring of electrons to CoQ10.	• Fatigue	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔		✔						✔			✔	
NDUFS3	rs4147730	A	• encodes one of the iron-sulfur protein (IP) components of mitochondrial NADH	• Fatigue • Mitochondrial dysfunction	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔		✔						✔			✔	
NDUFS7	•rs809359 •rs7258846 •rs1142530 •rs2332496	G T T A	• Transfer of electrons from NADH to the respiratory chain • CoQ10 is believed to be the immediate electron acceptor for the enzyme	• encephalopathy • cardiomyopathy • liver disease • Leigh syndrome • optic neuropathy • some forms of Parkinson's	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔		✔						✔			✔	

Gene & Variation	rsID	Risk Allele	Function	Health Risks	Actions to Take to Protect: Avoid/Reduce These: Xeno-Estrogens *	Caffeine	Alcohol	Exposure to cigarette smoke	Exposure to gas fumes	Acid-blocking Rx	Tylenol & other Rx	Char-broiled meat	Processed meats	Sugar	Processed Foods	Cosmetics and cleaners	Pesticides	Heated & oxidized fats	Actions to Take to Protect: Increase These: Exercise and Sweat	Hydration	Phase1 enhancing foods**	Omega 3 fats	Antioxidant intake	Foods that enhance Phase 1	Green Leafy Veggies	Sulfur-rich foods/MSM	Cruciferous vegetables	Mindfullness practices	Glutathione precursors	Glucoraphanin/Sulforapjane	Milk Thistle/Liver Support	Iron if deficient	Selenium	B vitamin intake	Folate (Vitamin B9)	Vitamin B12	Vitamin A	Vitamin C	Vitamin D	Vitamin E	Lab Testing: CBC	Vitamin D	Homocysteine	Hemoglobin A1c	Blood Spot Fatty Acid	DUTCH Test	Organic Acids	Stool Analysis	Advanced Lipid
COX6C	rs4626565	C	• Transfers electrons from cytochrome C to oxygen in the respiratory chain.	• fatigue	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔		✔						✔			✔			
COX5A	rs8042694	G	• Transfers electrons from cytochrome C to oxygen in the respiratory chain • involved in the regulation of cancer cell metabolism	• fatigue • increased risk of cancer	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔		✔						✔			✔			
ATP5FC1	rs1244414	T	• Encodes an enzyme called mitochondrial ATP synthase • catalyzes adenosine triphosphate (ATP) synthesis	• Fatigue • Low cellular energy • Huntington's disease.	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔		✔						✔			✔			
ATP5G3	rs36089250	C	•Encodes an enzyme called mitochondrial ATP synthase • catalyzes adenosine triphosphate (ATP) synthesis	• Fatigue • urea cycle dysfunction	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔			✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔		✔						✔			✔			

Genetic Markers That Can Influence Energy Metabolism

- CYP1A1
- CYP1B1
- CYP1A2
- CYP3A4
- FOX
- CTLA4
- BCM01
- MTHFR
- COMT
- IGF1R
- GLUT2
- UQCRC2
- DIO1 and 2
- PDE8B
- MTR, MTRR
- TSHR
- TPO
- ADRB2
- ADRA1A
- CRHR1
- NR3C1
- COMT

Genetic Lifehacks
Learn. Experiment. Optimize.

http://drritamarie.s3.amazonaws.com/materials/BioFit/GeneticLifeHAcksMitochondria.pdf

Mitochondria Topic Summary

The Mitochondria Summary Report is a handy way to see which articles may be most relevant to you. These summaries are attempting to distill the complex information down into just a few words. Please see the linked articles for details and complete references.

SIRT3

Gene	RS ID	Effect Allele	Your Genotype	Notes About Effect Allele
SIRT3	rs11555236	A	CC	Increased SIRT3; Increased longevity
SIRT3	rs11246020	T	CC	Reduced SIRT3; Increased risk of metabolic syndrome
SIRT3	rs185277566	G	--	Reduced SIRT3; Increased risk of heart attack.
SIRT3	rs28365927	A	GG	increased risk of fatty liver disease (NAFLD); increased risk of coronary artery disease

http://drritamarie.s3.amazonaws.com/materials/BioFit/SelfDecode-Fatigue.pdf

SelfDecode

Your Results in Details

Overall Fatigue

Life throws stressors at you on a continual basis, some big and many small. Generally, your body and mind are designed to handle them. You have limits, however, both physically and mentally. **These limits are influenced by your genetics** and many other factors that can leave you drained of energy and in need of recovery.

Your genetic predispositions may make you more susceptible to fatigue in a direct way or affect other key players in fatigue, such as anemia. Knowing these factors can help you make better choices regarding your health regimen.

TYPICAL LIKELIHOOD

Low Energy (Chronic Fatigue)

Typical likelihood of fatigue

TYPICAL

Red Blood Cells

Likely typical red blood cell count

LESS LIKELY

Anemia

Less likely to have anemia

TYPICAL NEED

Iron

Likely typical need for iron

HIGHER LEVELS

Hemoglobin

Likely higher hemoglobin levels

SelfDecode

Physical Fatigue

Pushed it to the limit and now you feel like an 80-year-old in need of a cane to walk? Your ability to handle physical activity and recover from it can vary a lot depending on your efforts to manage it. However, **your genetics plays a key role as well.**

Your genetic predispositions may impact physical activity in a number of ways, from your ability to recover in a timely manner to how much you can endure in the first place. **Check out this section for more details and information that will help you boost your energy levels.**

TYPICAL

Exercise Recovery

Likely typical recovery after exercise

TYPICAL

Endurance

Likely typical endurance

TYPICAL

Aerobic Capacity (VO2 Max)

Likely typical VO2 max

What To Recommend For Energy SNPs

- Decrease toxic load
- Avoid foods that interfere with mitochondrial function – sugar, processed grains, oxidized fats
- Consume foods and herbs that enhance mitochondrial function – greens, rainbow vegetables and fruits, omega 3 fats
- Reduce stress
- Intermittent fasting
- Supplement, if needed