Functional lab ranges cheat sheet!

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The Optimal Physical Exam:

Waist-to-Hip Ratio: This is a better measure of metabolic risk factor (i.e. your risk of cardiovascular disease, diabetes, etc) compared to weight or body mass index (BMI) alone. This is because it tells us about your body composition—how much of your body is fat versus muscle/water. This is so important since the single biggest health problem we face globally is the metabolic disaster that has led to a global epidemic of obesity, type 2 diabetes, and heart disease.

How to:

- Measure your waist:
    - Measure midway between the last rib you can feel and the top of the iliac crest (the topmost bony ridge of your hips). This is roughly where your belly button is.
- Measure your hips:
    - Measure the widest part of your hips a few inches below where your belt goes (these bony protuberances of the thigh bone are known as the greater trochanters)
- Divide your waist measurement by your hip measurement:
    - waist/hip= waist to hip ratio
- Optimal Women: <.8
- Optimal Men: <.9

DEXA Scan: This is a measure of your body composition (body fat versus lean muscle mass). This is a great alternative to body weight because it gives you more information about your risk factor for cardiometabolic conditions.

Nails:

- Ridges: may be caused by iron or zinc deficiency
- Pale nail beds: may be caused by iron deficiency
- Brittle nails: may be caused by low thyroid function or iron deficiency

- White spots: may be caused by protein, zinc, or iron deficiency

Skin: pale skin: may be caused by iron deficiency
- Dry skin - may be caused by dehydration, low essential fatty acids, low DHEA, low testosterone, or low estrogen.
- Oily skin- may be caused by elevated testosterone

Hair
- Dry hair: may be caused by low essential fatty acids
- Dandruff: may be caused by low essential fatty acids or zinc deficiency
- Premature grey: may be caused by copper or B12 deficiency
- Thinning hair:may be caused by protein, selenium or zinc deficiency

Mouth
- Cheilitis (cracks in the corners of the mouth): may be caused by B2/B9 (riboflavin or folate), iron, or zinc deficiency
- Glossitis: swollen/red tongue: may be caused by B2, B6, B12, or iron deficiency

Vital Signs:

Heart Rate: This shows how fast your heart is working and is a reflection of your cardiovascular health and stress (whether you're in a state of fight or flight constantly, or can relax into rest and repair). Your heart rate can also tell you about your thyroid health: a low or high heart rate may be reflecting an underactive (slow heart rate), or overactive (fast heart rate) thyroid gland.
- Normal 60-100 Beats per minute
- Optimal 60-80 Beats per minute

Heart Rate Variability: This reflects the complexity of your heart rate and the health of your autonomic or "automatic" nervous system, which controls all the subconscious processes of your body such as digestion, heart rate, breathing, etc. **The worst heart rate is a flat line**—no variability! The best is lots of variability. In other words, your heart rate isn't 72 but instead is 69, 71, 68 ½, 73, and so on. It varies from beat to beat.
- **Ideal: high HRV**

Blood Pressure: Your blood pressure is the resistance your heart is pumping against. You want it low enough so it doesn't damage your vessels, but high enough that it can get blood to your brain and limbs.
- Normal: less than 130/80
- Optimal 110/60-120/80

LAB VALUES

Nutrition

MCV: This is a measurement that tells you how large your red blood cells are. We care about this because it is a marker for iron, B12, and folate deficiency. All of these deficiencies can lead to fatigue or sub-optimal energy levels throughout the day.

- Normal 70-100 fL/red cell
- Optimal 85-90 fL/red cell

Methylmalonic Acid (MMA): Marker for B12 status. B12 is critical in gene expression, methylation, nerve function, mood, pretty much everything. Vegans have a high likelihood of being deficient in B12 because it's only found in animal products.

- Normal: 0-378 nmol/L
- Optimal: < 300 nmol/L

Ferritin: Ferritin is the storage form of iron, and is one of the most accurate ways to measure iron levels. Ferritin levels should be between 50-150 in women and 100-300 in men. I can't tell you how many times I see women with ferritin levels less than 50, or worse, in the single digits. This is because pre-menopausal women lose blood each month due to their menstrual cycles, which makes it harder to maintain levels. Many women are undereaters as well, which makes achieving optimal levels more difficult. If ferritin is high it could be a sign of inflammation, or it could be a sign of a genetic disorder called hemochromatosis or iron storage disease, which can be very dangerous.

- Normal men: 30-400 ng/mL
- Optimal men: 100-300 ng/mL
- Normal women: 15-150 ng/mL
- Optimal women 50-150 ng/mL

Red blood cell magnesium level (RBC Magnesium): This miracle mineral is required in over 300 chemical reactions in the body and is essential for the **production of ATP,** which is the energy that our body uses. Your car uses gas, your body uses ATP.

- Normal: 1.5-2.5 mEq/L
- Optimal: 2.0-2.5 mEq/L

Vitamin D: 70% of Americans have suboptimal levels of this vitamin. Why? We are not outside enough! Those who live in the northern part of the country are particularly at risk for deficiency

due to the angle of the sun during winter. 10am-2pm are the ideal times to be outside to get sun exposure for vitamin D levels, but most people will also need supplementation to maintain optimal levels. Vitamin D is actually a hormone: it regulates bone density, supports the immune system and has a big impact on our overall health.

- Normal: 30-100 ng/mL
- Optimal : 40-70 ng/mL

Omega 3 index: More than 98 percent of Americans are deficient in omega 3 fats. Omega 3 fats help balance out omega 6 fats and regulate our body's production of anti-inflammatory and inflammatory molecules.

- Normal: 2.9-12.9%
- Optimal: 8-12.9%

Micronutrient Test (Spectracell- ordered by your Functional Medicine Doctor): Up to 90% of Americans are not getting enough of the nutrients that are critical for healthy functioning. Spectracell is a micronutrient test that measures all of the essential vitamins and minerals to make sure they are at ideal levels so you can experience optimal health. The Spectracell test also looks at antioxidant levels.

Cardiovascular Labs

One of the biggest myths out there is that high cholesterol is the enemy. In fact, 75% of heart attacks occur in people with normal cholesterol levels, so there must be something else driving heart disease!

Total cholesterol: The total amount of cholesterol is not specific to the type of cholesterol. This number doesn't tell us too much because it lumps together HDL and LDL and it doesn't differentiate between the particle characteristics.

- Normal: 100-239 mg/dL
- Optimal 150-200 mg/dL

HDL: This is the "good cholesterol." It is protective against heart disease and can be raised with exercise.

- Normal men: 40-50 mg/dL
- Normal women: 40-50 mg/dL
- Optimal men: >50 mg/dL
- Optimal women: >60 mg/dL

LDL-C: LDL is a lipoprotein that carries cholesterol. It is atherogenic if it gets stuck under the subendothelial space. Remember, this still is not the best marker for cardiovascular disease.

- Normal: <100 mg/dL
- Optimal: <100 mg/dL

Triglycerides: Triglycerides is the storage form of fatty acids. Elevated triglycerides are associated with carbohydrate intolerance. Thus having high levels of triglycerides might mean that you need to cut out processed carbohydrates from your diet.

- Normal: <150 mg/dL
- Optimal: <100 mg/dL

Lp(a): A Lp(a) particle is a LDL particle with an Apo(a) particle attached to it. Elevated levels of Lp(a) are associated with aortic stenosis, and atherosclerosis.

- Normal: <75 nmol/L
- Optimal <50 nmol/L

LDL-P: This is the number of particles of lipoproteins present in the blood. We can compare this to LDL-C (LDL) which is the concentration cholesterol in the blood. This measurement is more important when considering risk factors for heart disease than the LDL measurement found on a standard lipid panel.

- Normal: 1138-1409 nmol/L
- Optimal: <700 nmol/L

Metabolic Labs

Fasting blood sugar: This is a snapshot of your blood sugar in time. This is not the best measurement for metabolic disease. Instead we want to look at HbA1C and fasting insulin (see below) to gather more information about how you metabolize sugars.

- Normal 65-99 mg/dL
- Optimal 75-85 mg/dL

HbA1C: HbA1C is a measure that calculates your average blood sugar over the last 3 months. This is a better indicator of your body's metabolic health than a single measure of blood sugar because it gives us more data points. Your body should be able to regulate your blood sugar tightly—not allowing it to fall too low or go to high.

- Normal 4.8% - 5.6%
- Optimal 4.8% - 5.5 %

Fasting insulin: If someone is moving towards diabetes, then the first marker to elevate is insulin, not blood sugar. After insulin has been elevated for a prolonged period of time THEN we will see a rise in blood sugar levels. Thus, fasting insulin and an insulin response test is essential if you are concerned about preventing metabolic dysfunction. And given that 1 in 2 people have diabesity, this is something you should be concerned about.

- Normal: 2.6−24.9 μIU/mL
- Optimal: 5 μIU/mL

Hormone Labs

Hormones are the messenger molecules of your endocrine system, and they're involved in the regulation of most of our body's systems. Imbalances in our hormones will create unnecessary symptoms, but the changes are often subtle. Most physicians just treat you when it's extreme.

Men's Hormones

Testosterone (total): This is the main male hormone for brain health, motivation, optimal energy, heart health and more. It is estimated that 39% of men over the age of 45 have low testosterone.

- Normal: 264-916 ng/dL
- Optimal: >600 ng/dL

Free Testosterone: The majority of testosterone is bound to sex hormone binding globulin (SHBG). Free testosterone is the amount of testosterone that is actually able to produce its effect on the body because it is not bound to a protein carrier.

- Normal: 20-50 years old: 7.2-26.5 pg/mL
    - > 50 years old: 6.6-24.0 pg/mL
- Optimal >15-25 pg/mL

Sex Hormone Binding Globulin (SHBG): This is the protein that binds testosterone (making it unusable).

- Normal:
    - 20-49 years: 16.5−55.9 nmol/L
    - >49 years: 19.3−76.4 nmol/L

DHEA-S: DHEA is a precursor to testosterone and estrogen and is produced in the adrenal glands. Low levels can show up as thinning of pubic hair, dry eyes, dry skin, low sex drive, and muscle wasting.

- Normal 71.6-530 μg/dL
- Optimal Men: 200-450 μg/dL
- Women: 150-250 μg/dL in women.
- *This begins to decline in our mid-20s so levels will be lower with advanced age.

Estrogen (estradiol): Estrogen is not just a female hormone! Men need estrogen to maintain balanced hormones, good libido, erections and a happy brain. Too much estrogen can sometimes cause “man boobs”.

- Normal: 7.6−42.6 pg/mL
- Optimal: 20-40 pg/mL

Luteinizing Hormone (LH): LH causes the production of testosterone in men.

- Normal: 1.7−8.6 mIU/mL

Follicle Stimulating Hormone (FSH): FSH is responsible for the production of sperm in men.

- Normal: 1.5−12.4 mIU/mL

Women’s hormones on day 19-21 of menstrual cycle

Day 1 = first day of bleeding (first day of a women’s period)

DUTCH (Precision Analytical): This is my preferred means of testing hormones in women. It gives so much more information about hormones than just blood levels. This is a urine test that tells us about your estrogen metabolites. Elevated levels of 4-OH E1 and 16-OH E1 may be more carcinogenic. While 2-OH E1 may be less carcinogenic. This test also tells about methylation pathways and about the enzymes 5 alpha reductase which can be upregulated in cases of hormonal hair loss or acne. The DUTCH test also gives information about B-vitamin status AND includes a 4-point cortisol test.

Progesterone: Progesterone is a female hormone that is calming (reduces anxiety) and prepares the uterus for pregnancy. Some women have normal values of progesterone but have too little progesterone when compared to the amount of estrogen they produce, which is why we want to look at the ratio of estrogen to progesterone.

- Normal: 1.8−23.9 ng/mL
- Optimal: 15-33 ng/dL during days 19-21 of your cycle

Estrogen (estradiol): Estrogen is a female hormone that supports a healthy mood, vaginal lubrication, energy levels, libidio, and helps protect your bones from osteoporosis.

- Normal: 43.8-211.0 pg/mL
- Normal post-menopausal: <6.0−54.7 pg/mL
- Optimal: 80-200 pg/mL

Luteinizing Hormone (LH): LH causes the production of testosterone in men and stimulates the release of an egg in women.

- Normal: 1.0-11.4 mIU/mL
- Normal postmenopausal: 7.7-58.5 mIU/mL

FSH: FSH is responsible for developing the follicles in the ovaries of women. In polycystic ovary syndrome (PCOS), FSH can be low, so low that ovulation and conception can't occur, which is why women with PCOS have infertility.

- Normal (d 19-21): 1.7-7.7 mIU/mL
- Normal Post-menopausal: 25.8-134.8 mIU/mL

LH/FSH Ratio: This ratio tells us about ovulation and fertility. On day 3 of your cycle the LH/FSH ratio should be about 2:1. In PCOS we often see elevated LH values. Because the LH levels are already quite high, there is no LH surge. Without this LH surge, ovulation does not occur, and periods are irregular. In PCOS this ratio can be between 2:1-3:1.

- Optimal: 2:1 (DAY 3 OF THE CYCLE*)

Testosterone: Testosterone is responsible for male sex characteristics in men, but is also essential in women's health. Testosterone ensures that we have optimal energy levels, motivation, and a healthy sex drive.

- Normal 20-49 years: 8−48 ng/dL
- Normal >48 years: 3-41 ng/dL
- Optimal: 20-40 ng/dL

Free testosterone (see above)

- Normal: 0-4.2 pg/mL
- Optimal: 1-2 pg/mL

SHBG (see above)

- Normal 20-49 years: 24.6−122.0 nmol/L
- Normal >49 years: 17.3−125.0 nmol/L

Thyroid/Adrenal Labs

Thyroid stimulating hormone (TSH): This is the most commonly run test to check for thyroid disease. 1 in 5 women and 1 in 10 men have low thyroid function. Common signs of hypothyroidism are cold hands and feet, trouble losing weight or weight gain, brittle hair and nails, dry skin, constipation, being tired all of the time, having trouble getting up in the morning, and brain fog or memory issues or depression. These symptoms warrant a thyroid panel to see if this gland is not kicking out the fuel it should be.

- Normal .45-4.5 µIU/mL
- Optimal 0.5-2.0 µIU/mL

Free T3 (fT3): This is the active thyroid hormone that actually exerts its effect on the cells. It is responsible for energy production, hormone production, regulating bowel movements, and so much more.

- Normal: 1.81−4.06 pg/mL
- Optimal: 3.0-4.4 pg/mL

Free T4 (fT4): T4 is the majority of the thyroid hormone that is produced. It must get converted to active thyroid hormone (fT3) in order to have any effect in our body. If free T4 is normal but fT3 is low, then you are not converting properly and might require supplementation with nutrients to help this process along.

- Normal: 0.82-1.77 ng/dL
- Optimal: 1-1.5 ng/dL

Thyroid Peroxidase Antibodies (TPO antibodies): 90% of the individuals who have hypothyroidism have autoimmune hypothyroidism (Hashimoto's disease). TPO is one of the markers for Hashimoto's. It is important to know the cause of hypothyroidism because you treat it differently from non-autoimmune hypothyroidism.

- Normal: 0−34 IU/mL
- Optimal: 0 IU/mL

Anti-thyroglobulin antibodies: Another marker for autoimmune thyroid disorder (Hashimoto's).

- Normal: 1-115 IU/mL
- Optimal: 0 IU/mL

Reverse T3: Reverse T3 is like the brake that stops your thyroid hormone production. Sometimes there are good reasons for higher Reverse T3 but often it's because something's wrong. T4 gets converted to rT3 under times of high stress, selenium deficiency, zinc deficiency, fasting, or not eating enough carbs for your body type.

- Normal: 9.2-24.1 ng/dL

Cortisol Test (Adrenal Stress Index): Cortisol is a hormone that is produced by your adrenal glands. It is responsible for waking you up in the morning and responding to stressful situations. The adrenals are two small glands that sit on top of your kidneys and they produce cortisol as well as the reproductive hormones above. These glands are one of our first responses to stress, and in chronic stress your adrenals get fatigued, your energy plummets, and it becomes difficult to manage your life. You could feel tired and wired, all at the same time. You might get palpitations or feel anxious or have trouble sleeping. You might crave salt. You may get dizzy when you stand up. You might have low blood pressure. You might even have sugar cravings, because your body can't regulate your blood sugar properly. All these are clues that you could have adrenal problems.

To test cortisol, it is best to test it at multiple time points throughout the day to ensure that your levels are normal AND that you have a normal pattern of cortisol release (highest upon waking, and lowest before bed).

Immune/inflammation Labs

CRP: CRP is a general inflammatory marker. hsCRP is specific to cardiovascular health but normal CRP is not specific to any system. Instead, it just tells us that there is inflammation somewhere. Low grade inflammation is a sign of chronic disease and should be addressed. Your doctor needs to dig deeper to find out where an elevation is coming from.

- Normal: 0.0−4.9 mg/L
- Optimal: <0.7 mg/L

Homocysteine: This is a general inflammatory marker, similar to CRP. It is also a marker of B12 and folate status, and gives us an insight to our ability to methylate. If this marker is elevated, then looking at causes for inflammation, as well as your MTHFR status, can be helpful.

- Normal: 0−15 µmol/L
- Optimal: 7 µmol/L

White Blood Cell Count (WBC): This is how many white blood cells your body is making. Our immune system can be thought of as an army. Chronically low levels of WBC tells us that your immune system is not sending enough troops out. This can be an early sign of autoimmunity or infection.

- Normal: 4.5-11 x 103/µL
- Optimal: 5.0-11 x 103/µL

Detox

Aspartate aminotransferase (AST): This is a blood test that can be run by all conventional lab companies. It is a liver function test that can indicate if there is liver damage occurring.
Normal: 0–40 IU/L
Optimal: 0–25 IU/L

Alanine aminotransferase (ALT)
his is a blood test that can be run by all conventional lab companies. It is a liver function test that can indicate if there is liver damage occurring.
Normal: 0–44 IU/L
Optimal: 0–26 IU/L

Gamma-glutamyl transpeptidase (GGT): This is a blood test that can be run by all conventional lab companies. It is a liver function test that is specific for toxin exposure and for fatty liver. This

value can be elevated in people with diabesity, drug exposures, excess alcohol intake and for many other reasons.
Normal: 0–65 IU/L

Mycotoxin test by RealTime Laboratories
Another cause for inflammation and immune system disturbances is mold. 30 to 50% of buildings in the US have mold in them. And if it is not remediated properly then the mold will remain and get worse. According to the EPA in 1985, indoor air quality can be up to 500 times more polluted than outdoor air. There are 200 types of mold that present serious health risks to humans or animals. These harmful species are known as “Toxic Molds” and produce potentially dangerous mycotoxins that can cause many medical conditions and symptoms.

Mitochondrial

Coenzyme Q10 (CoQ10): This is an essential nutrient for your mitochondria (energy producing centers of your cells) to make energy. CoQ10 is formed from cholesterol so people taking statins are likely deficient in this nutrient. It’s essential for heart health because our hearts contain some of the highest levels of mitochondria. But the serum CoQ10 test is definitely not the most comprehensive one to get for mitochondrial function. There is another test that includes CoQ10 levels and so much more. So if your doctor will order this test for you then there is no need to do a seperate CoQ10 measurement. The most important test for mitochondrial health is the organic acids test (OAT).

- Normal: 0.37−2.20 µg/mL

Organic Acid test (OAT) by Great Plains Labs
The organic acids test not only looks at mitochondrial function though it also examines how well our bodies are able to detoxify, your B vitamin status as well as whether you may have dysbiosis. Dysbiosis is a term that we will talk about in the gut testing section, it is when the bacteria in your gut are not in balance.

Genetics

All of the tests listed below can be run in the blood by most major lab companies.

Apolipoprotein E (ApoE): ApoE is a genetic marker for metabolic disorders and Alzheimer's. ApoE is also a helpful marker if you are curious about a high fat ketogenic diet. This is because people with the ApoE4 allele do not always respond well to a high fat diet, and especially to saturated fat. This population also does not respond well to statin therapy. They typically respond better to a moderate or lower fat diet or other types of fats. But remember, genetics load the gun, environment always pulls the trigger.

- ApoE2 = protective allele
- ApoE4 = increased risk for alzheimer's
    - ApoE3/4 (2-3x risk) APOE4/4 (12x risk)

MTHFR: This is one of the most well known genetic markers. MHFR is the center of our methylation cycle. Methyl groups are added to neurotransmitters and are involved in chemical reactions all throughout the entire body. We need methyl groups for hundreds of pathways in the body, it is essential for us to live. Having a mutation in MTHFR can hinder our ability to produce antioxidants- the compounded need to repair and protect our cells. MTHFR is needed to ensure proper cellular energy production as well as detoxification in the liver. We also rely on MTHFR for a proper immune and inflammatory response- both of which are essential for health. This gene influences homocysteine. So if you have elevated homocysteine levels (>8), then you should check your MTHFR status. This gene can tell you how your body is able to use b-vitamins, repair DNA, utilize detoxification pathways, and much more.

Anti-Aging

Telomeres: These are the caps on the end of your DNA. They shorten as we age. You can test your telomere length to see your biological age versus your chronological age.

IGF-1: This is a marker for growth hormone productions which is essential for mood regulation, firm skin, muscle maintenance, lower body fat composition and is known as the “anti-aging” hormone!

- Normal: 114-492 ng/ml
- Optimal: 200-300 ng/ml