1 Mitochondria are the crux of health, longevity, energy and fat loss

The role of mitochondria in health and disease

Darcy L Johannsen and Eric Ravussin

Abstract

Mitochondria play a key role in energy metabolism in many tissues, including skeletal muscle and liver. Inherent disorders of mitochondria such as DNA deletions cause major disruption of metabolism and can result in severe impairment or death. However, the occurrence of such disorders is extremely rare and cannot account for the majority of metabolic disease. Recently, mitochondrial dysfunction of a more subtle nature in skeletal muscle has been implicated in the pathology of chronic metabolic disease characterized by insulin resistance such as obesity, type 2 diabetes mellitus, and aging. This hypothesis has been substantiated by work from Shulman and colleagues, showing that reduced mitochondrial oxidative capacity underlies the accumulation of intramuscular fat causing insulin resistance with aging. However, recent work by Nair and
Latore-Pellizer et al. report that the transfer of mitochondrial DNA (mtDNA) from one mouse strain to another has pronounced effects on biology, demonstrating that mitochondrial genetic variation is not neutral and that mitochondrial–nuclear interactions are of central importance to mammalian physiology. Mitochondrial function is directly influenced by environmental changes, so the mitochondria must have a central role in mediating between environmental perturbations and genomic responses. High-energy molecules produced by mitochondria modify the cytoplasmic signaling proteins and epigenomic proteins that regulate nuclear DNA (nDNA) expression. These changes reprogram gene expression, altering expression of nDNA- and mtDNA-derived proteins that act in and on the mitochondria — these alterations feed back on mitochondrial function. If energetic homeostasis can be re-established, health and longevity are preserved. However, if genetic or environmental changes are too extreme, energy production declines, leading to disease and even death.
Are you getting the point that mitochondria are REALLY important yet?

If you want to

- Live to 100 and beyond
- Prevent dozens of diseases
- Live with maximal energy

You MUST focus on protecting and re-building your mitochondria.
“Mitochondria lie at the hub of the wheel of metabolism. Because mitochondria are also the concertmasters of innate immunity and inflammation, it makes them uniquely positioned to help the cell decide whether to devote energy and resources to ‘peacetime’ metabolism, or cellular defense.”

– Robert Naviaux, MD

How the healthy environment looks
And here is how the unhealthy environment looks
It turns out that your mitochondria can’t do both roles at the same time!

So the more you ask your mitochondria to go into defense mode, the less they can operate in energy mode!

And this team of scientists has discovered why mitochondria get switched off.

They call it the **Cell Danger Response**

I believe that this research will help unlock the secrets to beating numerous different kinds of chronic diseases, but especially chronic fatigue.

“The cell danger response (CDR) is the evolutionarily conserved metabolic response that protects cells and hosts from harm. It is triggered by encounters with chemical, physical, or biological threats that exceed the cellular capacity for homeostasis.”
“Mitochondria lie at the hub of the wheel of metabolism, coordinating over 500 different chemical reactions as they monitor and regulate the chemical milieu of the cell…”

“It turns out that when mitochondria detect ‘danger’ to the cell, they shift first into a stress mode, then fight mode that takes most of the energy-producing metabolic functions of mitochondria off line.”

Etch this image into your mind, because what you see here is the fundamental cause of fatigue.

The more your mitochondria are defending against threats, the more fatigue you’ll feel.

To get more of one, you have to decrease the other.

In other words, I am saying that...

Your energy levels are simply a reflection of the degree that your mitochondria are mostly SWITCHED ON or SWITCHED OFF.
Let this sink in: If you have chronic lack of energy, that simply means that your mitochondria have shifted away from ENERGY MODE towards DEFENSE MODE.

This is the big breakthrough...It’s that mitochondria are not just energy generators like almost everyone believes.

They are also DANGER SENSORS and when there are threats present, they shift OUT of ENERGY MODE and into DEFENSE MODE.
And when they switch into DEFENSE MODE, you have the SYMPTOM of fatigue.

If all of this seems abstract to you, let me ground this in your own personal experience so it makes sense...

Just think for a moment about the last time you got really sick with a cold or flu or some other infection...

Remember how your body felt fatigued and a lot lower energy than you do normally?

Remember how your body needed more sleep?

That is what happens when the body engages the Cell Danger Response.

FATIGUE is THE symptom of the body engaging the CDR and switching off your mitochondria.

The reason why you feel fatigued is because your body has literally shut down energy production in a large portion of your body’s mitochondria!

That is the key to understanding what fatigue really is.

Fatigue is what happens when your mitochondria have been taken off line.

The more they’ve been taken off line, the more fatigue you have.

It turns out that studies have now shown that’s exactly what’s going on in chronic fatigue...
What these researchers discovered is that people with chronic fatigue actually have their mitochondria largely SHUT OFF!

Their conclusion:

**Fatigue is the result of the body shutting down the metabolism and turning off mitochondria.**

“Eighty percent of the diagnostic metabolites were decreased, consistent with a hypometabolic syndrome...”

Our data show that despite the heterogeneity of factors leading to chronic fatigue syndrome, the cellular metabolic response in patients was homogeneous, statistically robust, and chemically similar to the evolutionarily conserved persistence response to environmental stress known as dauer.”

**They are saying that chronic fatigue is a hypometabolic (low metabolic rate) condition that is similar to DAUER.**
Dauer is what certain kinds of worms go into when put in a toxic or harsh environment.

(Dauer is a German word for endurance).

These worms have been studied extensively by biologists due to their unique capacity to endure harsh environments.

They can live 4-8 times longer in a toxic environment by entering into this dauer state.

They shut down their metabolism just to survive – keeping all their body’s machinery on just enough to stay alive – and hopefully switch back on when in a safer, less toxic environment.

In other words, what they found is that the biochemistry of a person with chronic fatigue suggests that their body is going into a hibernation-like mode and shutting down energy production.

The body is basically keeping on just enough of the machinery to stay alive, but not enough to actually function well.

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That seems really strange until you start to understand everything I just told you about the CDR.

All of the sudden, it all starts to make sense.
The fact that animals can live much longer in a harsh environment by entering a low energy state is the key to understanding this.

Shifting into a low energy (FATIGUE) state actually PROTECTS the body and helps it to survive!

Why does turning off the mitochondria protect the body?
Let me give you an example of why our bodies are designed this way...

Many types of viruses and bacteria hijack the mitochondria in our cells to fuel their own replication.

It turns out that our mitochondria are designed to DETECT when this is happening and then to SHUT DOWN energy production and even to SELF-DESTRUCT to prevent the microorganism from hijacking it and fueling its own replication.

If we didn’t have the CDR, these little bugs would be able to replicate and spread like wildfire.

Our bodies actually shut down the mitochondria and CAUSE fatigue in the process of trying to PROTECT US.

It works to help you survive in a harsh environment, but unfortunately, it also has big consequences – especially that it wrecks your energy levels.
Think of it like this: Imagine that someone threw poisonous gas outside your house...

It would obviously be a terrible mistake to say “oh no big deal, let’s just resume function as normal, keep the windows open and let the fresh air in and maybe later, we can go for a walk outside.”

If you kept functioning normally, you would quickly die.

If you want to survive, your immediate reaction is to shut all the doors, close all the windows and sit around inside your house until the gas cleared up.

**AND THAT IS EXACTLY WHAT CELLS DO!**

**3 THE BREAKTHROUGH:**

What this means is that fatigue is a SYMPTOM of your body trying to protect you from a harsh environment!

Fatigue happens when your mitochondria are constantly trying to protect the body from threats instead of producing energy.

Your body is DESIGNED to decrease the energy producing machinery in direct proportion to the harshness of the environment your body is in.

The harsher the environment your body is in, the more your mitochondria will shift out of ENERGY MODE into DEFENSE MODE, and the more FATIGUE you will feel.
Ultra harsh environments and ultra intense stress exposures create severe, debilitating fatigue. (Almost hibernation-like states).

Mildly harsh environments create mild fatigue.

It turns out that mitochondria being shut down also cause several other familiar symptoms...

In order for that heart muscle to work well, the mitochondria of the heart must be healthy.

Without a heart that is always working well, everything else in the body suffers.

See, the heart pumps blood. And blood carries oxygen and nutrients, which all of our cells depend on to work properly.

Without efficient delivery of oxygen and nutrients, none of the organ systems of the body – the brain, the muscles, the liver, the skin, the gut, etc. – can work well.

One of the things many people with fatigue notice is that they have a poor tolerance to exercise, poor stamina to do it, and it’s really hard for them to increase their fitness. Also, many people notice that they feel much better sitting or laying down than standing up.
The Brain

The brain happens to be the body part that is most dense with mitochondria.

So, mitochondrial dysfunction simultaneously causes both poor blood delivery to the brain, and poor energy production by mitochondria in brain cells.

This is why so many people with fatigue suffer from brain fog, difficulty focusing, headaches/migraines, mood problems like anxiety and depression, and poor cognitive performance.

The Muscles

Poor mitochondria leads to the muscles having very poor stamina, and switching over to glycolysis, which does not need oxygen or the mitochondria.

The problem is that it also results in huge amounts of lactic acid being produced, which not only causes pain and inflammation, but also depletes the body of ATP.
**THE SKIN**

When the heart is not working well, the body pools blood away from the surface blood vessels and towards the organs.

This means that circulation to the skin is hindered and results in all sorts of issues such as; the body becoming intolerant of heat ad intentionally decreasing thyroid hormone to lower your metabolism and run the body cooler.

These changes lead the body to accumulate more toxins.

**THE LIVER**

The liver is a primary place for detoxification.

When blood supply to the liver is not optimal and the liver’s mitochondria are not working well, the liver’s cells do not do their job well.

That means accumulation of toxins. Combined with the lack of detoxification from the skin, this is bad news.

**THE GUT**
Poor blood supply and mitochondrial function in the gut creates all sorts of havoc – poor production of digestive juices, leaky gut, immune system dysfunction leading to gut dysbiosis, chronic inflammation, food intolerances, allergies, autoimmunity, and more.

All of which can of course, cause vicious cycles that make your fatigue worse, fast. Perhaps the biggest problem that mitochondrial dysfunction creates is leaky gut.
HOW POOR MITOCHONDRIAL FUNCTION IMPACTS YOUR BODY

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www.thenergyblueprint.com
Your energy is a reflection of what kind of environment your mitochondria perceive themselves to be in.

KEY: Normally the body gets itself OUT of CDR mode and shifts back into normal mode. But it can get locked in CDR mode.

So if you’re thinking “But I live a healthy lifestyle.”

Well, that’s why – your body is likely stuck in CDR mode.

**Here is the big secret key to understanding fatigue:**
When your mitochondria are forced to defend against threats constantly, the body downshifts all the energy-generating systems.
This is the fundamental cause of fatigue.

To put this directly...

Your level of energy is directly proportional to the degree that your mitochondria are defending against threats.

So if you are fatigued, all that means that your mitochondria have been shifted away from ENERGY MODE and shifted towards DEFENSE MODE.

So what are these factors that trigger the CDR and shift our mitochondria into DEFENSE MODE?

There are numerous different types of stressors that will cause your mitochondria to switch on the CDR and switch out of ENERGY MODE INTO DEFENSE MODE.
Most people have AT LEAST 5 or 6 of these factors going on at any given time!

When the mitochondria sense these threats, they engage the Cell Danger Response.

So step 1 is simply to get rid of these Danger Response triggers.

You can take all the fanciest and most expensive supplements in the world, eat the best diet, and spend tens of thousands on medical treatments, but if you don’t put the time and energy into getting rid of the Cell Danger Response triggers in your environment, all your efforts will get you nowhere.

Remember, the big key to all of this is that the more your mitochondria are being forced to be in "danger and defense mode," the more their "energy generation mode" gets shut down!
Your body is basically stomping on the brakes instead of the accelerator pedal. To get our body into energy mode, we first have to take our foot off the brake. We have to get our mitochondria out of “danger and defense mode”!

Let’s go over some of the most important triggers of the Cell Danger Response that you need to focus on to start taking the stress off your mitochondria:

#1

**Blue light at night:**
Disruption of your body’s circadian rhythm – your 24-hour clock in your brain that controls when you wake up and when you sleep – is a major factor in triggering mitochondrial dysfunction.

**2 Main Reasons Why:**
1. Melatonin is a potent antioxidant that protects mitochondria
2. Mitochondria re-charge energy stores and antioxidant supplies each night

#2

**Inflammatory Fats (Vegetable Oils)**
As with the previous point, the more inflammation in your body, the more you’ll shut down your mitochondria. Vegetable oils in particular (and more generally, consuming a large amount of omega-6 fats and not enough omega-3s) will make your body primed for inflammation. The main culprits here to get out of your diet are vegetable oils which are
commonly used for cooking and are ingredients in most processed foods – things like canola-, corn-, soy-, sunflower-, and safflower oil.

#3

**Food Intolerances**

Common Symptoms of Food Intolerances...

- Bloating, Gas or Digestion Issues
- Skin Rashes of any kind
- Dark Circles under the eyes
- Brain fog or food coma after eating
- Runny Nose or Excess Mucus
- Muscle/Joint Aches and Pains
- Depression and Mood Swings

These Foods Account for 75%+ of Food Intolerances

- WHEAT (and gluten)
- CORN
- SOY
- DAIRY/MILK
- EGGS
Any source of inflammation in the body will promote more of the Cell Danger Response. Even food that you are slightly intolerant or allergic to will trigger an immune and inflammatory response.

Eliminating these 5 foods from your diet for 4-8 weeks and then re-introducing them (individually) to test for reactions... is a smart move.

#4

**Refined Sugar**

Several studies have now shown that refined sugar may be directly toxic to our mitochondria.

The solution here is simple and straightforward: Get refined and processed sugars OUT of your diet. Eat whole foods.

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**Fructose-Rich Diet Affects Mitochondrial DNA Damage and Repair in Rats.**

Cioffi E1, Genese E2, Lussana B3, Ziello A4, Mazzoni A6, Crescenzo R6, Liverini G7, Lanni A8, Goglia E9, Iones S10.

**Author information**

**Abstract**

Evidence indicates that many forms of fructose-induced metabolic disturbance are associated with oxidative stress and mitochondrial dysfunction. Mitochondria are prominent targets of oxidative damage; however, it is not clear whether mitochondrial DNA (mtDNA) damage and/or its lack of repair are events involved in metabolic disease resulting from a fructose-rich diet. In the present study, we evaluated the degree of oxidative damage to liver mtDNA and its repair, in addition to the state of oxidative stress and antioxidant defense in the liver of rats fed a high-fructose diet. We used male rats feeding on a high-fructose or control diet for eight weeks. Our results showed an increase in mtDNA damage in the liver of rats fed a high-fructose diet and this damage, as evaluated by the expression of DNA polymerase y, was not repaired; in addition, the mtDNA copy number was found to be significantly reduced. A reduction in the mtDNA copy number is indicative of impaired mitochondrial biogenesis, as is the finding of a reduction in the expression of genes involved in mitochondrial biogenesis. In conclusion, a fructose-rich diet leads to mitochondrial and mtDNA damage, which consequently may have a role in liver dysfunction and metabolic diseases.
Note: Natural sugars found in fruit are not a concern – the toxic effect of sugar on mitochondria only happens with large doses that would typically be found in soda, desserts, candies, and processed foods.

#5 Advanced Glycation End Products (AGEs)

One thing that contributes to insulin resistance and diabetes that most people are unaware of is something called AGEs (advanced glycation end products).

These are toxic byproducts of proteins and lipids that react with sugar that sometimes form in our food – particularly protein and fat-rich animal foods.
When you consume lots of AGEs in your diet, it worsens your metabolic health, promotes inflammation and insulin resistance, and causes mitochondrial dysfunction.

One simple strategy you can use to combat insulin resistance/diabetes, inflammation and mitochondrial damage is to lower your intake of AGEs. How do you do that?

**Use gentle cooking methods**

Gentle cooking methods such as steaming, boiling and poaching at lower temperatures are generally superior to frying, roasting and grilling for health.

Deep-fried food is as close as food gets to toxic.

(The way you cook is especially important when preparing meat/animal foods rich in protein and fat, which are especially prone to AGE-formation).

If you want to keep your mitochondria healthy, choose gentle cooking methods for all your animal foods!

#6  

**Summer Vs. Winter Metabolism**  
**(Occasional Winter Metabolism)**

Another important cause of mitochondrial dysfunction is something called the Perpetual Summer metabolism. This is when we are chronically consuming a carbohydrate and sugar-rich diet, every day, year-round. Robert Naviaux, MD, believes this is a significant trigger of the Cell Danger Response.

The basic idea here is in a natural environment (like the one we humans evolved in), the seasons caused changes in the amount of food available to us and the types of foods available to us. In summer, food was more
abundant and we ate more (triggering certain cell and mitochondrial signaling pathways) and then in the winter, we tended to eat less food (and this also triggered opposing pathways). Also, regarding the types of foods, fruit and other carb sources were predominantly available only during the warmer months, and then during the other part of the year, we shifted more towards reliance on protein and fat-rich foods.

Naviaux believes that this cycling between summer and winter metabolism is critical for the health of our mitochondria. In Naviaux’s words:

“Many developed nations now experience an ‘endless summer’ of calorie availability, decreased physical exercise, and an absence of the historical norm of winter caloric restriction. This has led to modern epidemics of obesity in both adults and children, and to a growing tide of chronic disease traceable to cellular inflammation.”

The basic idea here is of course to do this cycling between summer and winter metabolism to mimic what our ancestors did and what our bodies have evolved for. There is also evidence indicated that periods of glycogen (stored carbohydrate) depletion and low-carb eating can boost mitochondrial function.

Shifting towards lower carb and higher fat consumption during the colder months and more of a higher carb and lower fat diet in the warmer months is likely a smart idea.

3 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1867088/
4 http://onlinelibrary.wiley.com/store/10.1111/eci.12591/asset/eci12591.pdf?v=1&t=j1w9ym4e&s=cd7da6ff5d2560d4ec2392b674fd0a73e20ba8f87
5 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2367001/
#7

- Food colorings
- Food preservatives
- Artificial flavorings
- Carageenan

**Review of harmful gastrointestinal effects of carrageenan in animal experiments.**

J K Tobacman

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This article has been cited by other articles in PMC.

**Abstract**

In this article I review the association between exposure to carrageenan and the occurrence of colonic ulcerations and gastrointestinal neoplasms in animal models. Although the International Agency for Research on Cancer in 1982 identified sufficient evidence for the carcinogenicity of degraded carrageenan in animals to regard it as posing a carcinogenic risk to humans, carrageenan is still used widely as a thickener, stabilizer, and texturizer in a variety of processed foods prevalent in the Western diet. I reviewed experimental data pertaining to carrageenan’s effects with particular attention to the occurrence of ulcerations and neoplasms in association with exposure to carrageenan. In addition, I reviewed from established sources mechanisms for production of degraded carrageenan from undegraded or native carrageenan and data with regard to carrageenan intake. Review of these data demonstrated that exposure to undegraded as well as to degraded carrageenan was associated with the occurrence of intestinal ulcerations and neoplasms. This association may be attributed to contamination of undegraded carrageenan by components of low molecular weight, spontaneous metabolism of undegraded carrageenan by acid hydrolysis under conditions of normal digestion, or the interactions with intestinal bacteria. Although in 1972, the U.S. Food and Drug Administration considered restricting dietary carrageenan to an average molecular weight > 100,000, this resolution did not prevail, and no subsequent regulation has restricted use. Because of the acknowledged carcinogenic properties of degraded carrageenan in animal models and the cancer-promoting effects of undegraded carrageenan in experimental models, the widespread use of carrageenan in the Western diet should be reconsidered.
Prescription And Over The Counter Drugs

One of the biggest and most common causes of mitochondrial dysfunction is actually the use of prescription and over-the-counter drugs.

Things like ibuprofen, antidepressants, Tylenol, acid reflux medicines, statin drugs, and hundreds of other very commonly used drugs will cause mitochondrial damage when used regularly over long periods of time even at normal dosages.

Dr. Joseph Pizzarno, author of The Toxin Solution, talks about how he’s still able to play basketball into his 70s while all his friends that he plays with all inevitably seem to stop in their 50s because their bodies get too beat up.

He believes it’s largely due to mitochondrial damage from chronically taking ibuprofen and other over-the-counter painkillers and anti-inflammatory drugs.
If you are consuming one of those, talk to your doctor about getting off or finding an alternative that is not toxic to mitochondria.

Note: Short stints of use with these compounds is not likely a huge problem, but chronic and frequent use is a huge problem for your mitochondria.

Also note that with comprehensive lifestyle changes (like what I am recommending here), many people are able to improve their health enough to go off drugs entirely.
Electro Magnetic Fields (EMFs)

Another trigger that will put your mitochondria into chronic Defense Mode and shut down energy production is chronic EMF exposure. If you constantly have a wifi emitting device on or next to your body, you’re wearing out your internal antioxidant defense system and triggering your mitochondria into Defense Mode. A number of studies have shown that Electromagenetic fields (EMFs) from such devices can negatively affect mitochondrial function.6 7 And negative hormonal effects have been linked to EMF exposure from cell phones.89

Here are some simple and powerful strategies to minimize your EMF exposure:

• Don’t wear your cell phone in your pocket.
• Turn your cell phone on airplane mode when you don’t need it.
• Talk on speaker phone or use a headset (non Bluetooth) rather than putting your phone next to your brain.
• Don’t have a laptop sitting on your lap for hours each day.
• When using a desktop computer, keep it as far away from you as possible.
• Don’t sleep with any electronic device on your body or within several feet of your body.

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7 http://www.tandfonline.com/doi/abs/10.3109/09553002.2015.1101648
8 https://www.ncbi.nlm.nih.gov/pubmed/20714683
9 http://onlinelibrary.wiley.com/store/10.2164/jandrol.111.014373/asset/jandrol.111.014373.pdf?v=1&t=j1w81jod&s=9ec052fa250a45a35aec9bde90c391ed677fe7db
Believe it or not, simply sitting around too much is actually toxic to your mitochondria! To understand why, I’ll have to explain a bit about how your mitochondria work (and I’ll try to do that with the least technical language possible).

Basically, the way your mitochondria work to produce cellular energy (ATP) is by
harnessing electrons from food and then pass those electrons through something called the “electron transport chain.” The electrons are passed through 4 enzyme complexes in this electron transport chain, and each time an electron is passed, a H+ (hydrogen ion or proton) is passed across the mitochondrial membrane from one side of the membrane to the other.

As this happens, those H+ protons accumulate on one side of the membrane. This creates a gradient, which serves as a source of potential energy. (I.e. Simply having a high concentration of a substance on one side of a membrane and a low concentration on the other side created a potential energy, because the tendency of the substances is to move across the membrane and equalize the concentrations.)

The mitochondria uses this potential energy by passing the H+ protons back across the membrane through a special pump (called the ATP synthase pump), and in the process, the body turns ADP into ATP.

Here is all of this illustrated:

Now, follow me here because now it gets a little more complex...

The mitochondria are ALWAYS trying to turn ADP into ATP, to make sure that there is constantly a reserve of cellular energy (ATP) ready to go in case you need it. So it’s always trying to get rid of the ADP that is present and turn it into ATP. **And that happens even if the cell is not really using up the ATP.**

So in that scenario, it creates a big problem. See, in order to properly utilize the electrons and the H+ gradient to make ATP, you need to **burn off some of that ATP**
and have some ADP built up.

When there is very little or no ADP available, the ATP synthase pump basically shuts down due to the lack of raw materials to make any more ATP. (It can only make ATP from ADP). When the ATP synthase pump shuts down, those H+ protons accumulate in that intermembrane space because they’re not getting pumped back in by the ATP synthase pump.

As that gradient becomes bigger, the small amount of energy from the passing of electrons down the electron transport chain is no longer sufficient to force more H+ protons into that already too concentrated space. That causes electron flow down the electron transport chain to get backed up.

This creates a very big problem, because now some of the electrons get released prematurely in the mitochondria (instead of getting passed down the electron transport chain). Then those electrons bind to oxygen, which creates a toxic free-radical called superoxide, which then damages the mitochondria.

If all that was too much to understand, the basic idea is that being sedentary (i.e. not burning off energy regularly) creates a traffic jam in your mitochondria that results in mitochondrial damage.

If you don’t use up energy – by being active – you’ll end up with damaged and dysfunctional mitochondria. (And by the way, many will get so damaged that they self-destruct and basically commit suicide, so you will actually end up with less mitochondria). For your mitochondria to stay healthy and keep pumping out energy, you need to create a slow and steady use of energy by not being sedentary.

The solution here doesn’t need to be about doing tons of intense exercise. It’s much more about engaging in very gentle movement frequently throughout the day. So if you work a desk job, getting a stand-up desk or using an under desk cycle, or at the very least, setting a timer that cues you to get up every 30 minutes to do some walking or gentle movement or stretching is a must.
Overexercising

Canadian and European researchers, led by Robert Boushel, director of the University of British Columbia's School of Kinesiology in Canada, analyzed tissue samples from 12 male volunteers in Sweden.

All the participants were healthy but described themselves as either untrained or only moderately active.

The men took part in high-intensity training over a 2-week period. The exercise regimen involved repeated 30-second all-out sprints, followed by rest periods.

The researchers observed signs of stress in the muscle tissues of the participants after carrying out ultra-intense leg and arm cycling exercises.

Tests showed that their mitochondria, the "powerhouse of cells," were only functioning at half their capacity after training, reducing their ability to consume oxygen and to defend against damage from free radicals.
Psychological/Emotional Stress

In a study done in women where they compared one group on a junk food diet who were not stressed to another group on the same diet but also under chronic stress, the women who were chronically stressed had double the level of oxidative stress compared to those who ate a junk food diet and were not stressed.

# Mitochondrial dynamics and viral infections: A close nexus.

Khan M1, Syed G1, Kim S1, Siddiqui A2.

Abstract
Viruses manipulate cellular machinery and functions to subvert intracellular environment conducive for viral proliferation. They strategically alter functions of the multitasking mitochondria to influence energy production, metabolism, survival, and immune signaling. Mitochondria either occur as heterogeneous population of individual organelles or large interconnected tubular network. The mitochondrial network is highly susceptible to physiological and environmental insults, including viral infections, and is dynamically maintained by mitochondrial fission and fusion. Mitochondrial dynamics in tandem with mitochondria-selective autophagy ‘mitophagy’ coordinates mitochondrial quality control and homeostasis. Mitochondrial dynamics impacts cellular homeostasis, metabolism, and innate-immune signaling, and thus can be major determinant of the outcome of viral infections. Herein, we review how mitochondrial dynamics is affected during viral infections and how this complex interplay benefits the viral infectious process and associated diseases.
Insulin Resistance
(Cause Of Constant Oxidative Damage In The Cell)

If you are very overweight, more than likely you have insulin resistance. (Note: Type II diabetes is severe insulin resistance. Many people also have insulin resistance not quite severe enough to get them classified as having type II diabetes, but who nonetheless have insulin resistance that causes problems).

One of the big problems with insulin resistance is that it results in cellular and mitochondrial damage. Specifically, it can cause the buildup of certain toxic compounds called ceramides, which damage mitochondrial function.101112 13

While there are many causes of insulin resistance, including poor diet, being very sedentary, smoking, drinking, poor sleep, mineral deficiencies, and many types of toxins, the biggest cause is the accumulation of body fat itself. The more body fat you accumulate, the more likely you are to have insulin resistance.

This is because the fuller your fat cells get, the less effective they get at doing their job of trapping excess nutrients floating around in the blood – they become leaky, and that leads to chronic excesses of nutrients like sugar and fat floating around in the bloodstream.

10 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279553/
11 https://www.hindawi.com/journals/omcl/2012/479348/
12 http://www.jbc.org/content/early/2016/10/04/jbc.M116.737684
13 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3994704/
While correcting many of the factors I just mentioned – such as sleep, diet, stress, alcohol drinking habits, correcting mineral deficiencies, and detoxification – can profoundly help decrease insulin resistance, the most powerful thing you can do is to lose excess body fat.

#15

Toxins

In addition to everything mentioned above, there are also dozens of other types of toxins that cause mitochondrial damage that we’re all exposed to on a near daily basis – in the air we breathe, the water we drink, the chemicals we use for various purposes, the personal hygiene and beauty products we apply to our skin, and the food we eat.

This could be the subject of an entire book itself, so I’ll just give a quick rundown of some common compounds that most of us are exposed to that damage mitochondria:

- Neurotoxic pesticides in conventionally-raised crops (glyphosate being a prime example of a mitochondrial toxin).
- Personal care products and perfumes, which are high in things like lead, and hormone disrupting chemicals.
- Off gassing of chemicals from carpets, furniture, clothing, mattresses, paint, blankets, children’s toys, cookware, and cleaning products.
- Fumes at the gas station.
- Exhaust from cars while driving.
- Air pollutants from industry (This has a ton of research linking it to all sorts of diseases and shorter lifespan).
- Heavy metals in our food and water supply.
- Chlorine-disinfection byproducts and prescription drug residues in our drinking water.
Flouride

Flouride is another common toxin that will poison your mitochondria and switch off cellular energy production. It does this through two main mechanisms:

Inhibiting thyroid function. Remember that thyroid hormones are a main controller of your metabolic rate, which in turn affect how much energy your mitochondria are producing. Believe it or not, flouride is actually given as a treatment to people with hyperthyroidism (that’s too MUCH thyroid hormones) in order to switch off the thyroid gland.

And consider this: The amount of flouride in a single glass of tap water is enough to cause a significant amount of thyroid inhibition. Here’s Thyroid expert Izabella Wentz, PharmD on that: “Flouride is effective as a thyroid suppressor at doses of 0.9-4.2 mg per day for hyperthyroidism.

Most adults in fluoridated communities are ingesting between 1.6 and 6.6 mg of flouride per day from water inadvertently suppressing their thyroid function!”

In addition, flouride also directly inhibits energy production in the mitochondria.

So it’s a double whammy of shutting down your energy production in the cell and slowing your whole body metabolism. (Recall that fatigue is associated with slow metabolic rate!)

14 https://thyroidpharmacist.com/articles/fluoride-and-your-thyroid/
16 https://www.hindawi.com/journals/isrn/2012/403835/
17 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0100768
Bisphenol A (BPA)

BPA is another common toxin that causes both hormonal dysfunction and mitochondrial dysfunction. As Dr. Chris Meletis writes:

“In one animal study published in January 2013, exposure to BPA—a toxin commonly found in some plastics, food storage containers, liners of metal cans and cash register receipts—caused mitochondrial defects in beta cells. These defects included depletion of ATP, loss of mitochondrial mass and membrane potential and alterations in expression of genes involved in mitochondrial function and metabolism. ...

BPA's effects on the mitochondria aren't limited to beta cells. In another animal study published in June 2012, researchers found that even low levels of BPA—below the no observed adverse effect level—can cause liver damage and mitochondrial dysfunction by increasing oxidative stress and inflammation. The study authors administered two doses of BPA, 0.05 and 1.2 mg/kg body weight per day, for five days to mice. Both treatments damaged the structure of the liver mitochondria, although oxygen consumption rate and expression of the respiratory complex decreased only at the higher dose.

In the BPA-treated mice, the expression of the mitochondrial respiratory complex III and V was also reduced compared to the
control mice. During BPA treatment, antioxidant enzyme levels in the liver plummeted, so that liver cells had no protection against the oxidative stress caused by BPA, resulting in mitochondrial dysfunction.

When these same researchers conducted an *in vitro* study using a lower and higher dose of BPA, both doses caused a decline in the oxygen consumption rate, ATP production and the mitochondrial membrane potential."18

In short, BPA is a very common toxin in people’s bodies (given all the plastics we use), and it is very bad news for your mitochondria.

To deal with this, try to minimize or eliminate your consumption of food and drinks from plastics. Drink water out of glass or stainless steel bottles. Minimize canned food consumption. And at home, store your food in glass Tupperware.

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18 [http://www.cpmedical.net/newsletter/mitochondria-resuscitation-the-key-to-healing-every-disease](http://www.cpmedical.net/newsletter/mitochondria-resuscitation-the-key-to-healing-every-disease)
1. **Remove processed foods, limit/eliminate alcohol, and eat organic if possible**

Processed foods often have hormonal disrupting chemicals in them like phthalates and BPA, natural colorings/flavorings, and things which promote leaky gut, like carrageenan.

Eat foods that minimize your exposure to pesticide and herbicide residues

2. **Purify your water**

You simply MUST get a water filter for your home and be filtering both your drinking water and shower water. Tap water is filled with fluoride, chlorine and chlorine disinfection byproducts (which are even more toxic than chlorine), pesticide residues, prescription and over-the-counter drug residues, and all sorts of environmental pollutants.

If you drink tap water or only use a cheap basic filter like a Brita or something similar, you are slowly poisoning yourself every day with the water you drink and bathe in.

You can potentially get a whole-house filter *(this is the one I recommend)*. Or separate drinking water filters for your drinking water and shower heads. This is the drinking water filter I recommend. And this is the shower filter I recommend.
3. Purify your air

Air pollutants are another common source of pollutants in our body. And if we expect to get the toxins out, we have to stop putting them in! If you live in a city in an urban environment, getting an air purifier in your home is a MUST (especially for your bedroom while you sleep). Cities are simply filled with air pollution.

If you have chemical smells in your home (or you’re sensitive to chemicals), I suggest getting the top-of-the-line air purifier – that’s the IQAir Chemical Multigas air purifier.

If you don’t have any notable chemical sensitivity, I suggest either the IQAir HealthPro, or the Whispure.

(After spending many weeks researching air purifiers, these are my top choices and the ones I use for my own family).

Also note that certain plants can also be supportive in purifying the air in your home – here is a list of the top plants for that purpose. If you can, fill your house with these, or at least your bedroom. You’ll feel the difference in how you wake up.
4. Ditch kitchen products full of chemicals

Get rid of Teflon cookware (and all non-stick cookware, even ones that say they don’t use Teflon, because they use similar chemicals that are just as toxic). The best choices for cookware are glass baking dishes, ceramic-coated pots and pans, and cast-iron skillets.

Get rid of plastic cooking utensils. Use wood utensils.

Use chlorine-free parchment paper instead of aluminum foil.

Replace your plastic Tupperware with glass containers. Pyrex makes good glass Tupperware, and glass mason jars are the best way to store food. (You can get them here). Don’t store hot and/or fatty foods in plastic, ever.

5. Get rid of the unnatural personal hygiene and beauty products and replace them with healthy ones

Most people don’t realize their shower products, perfumes and colognes, and make-up are often packed with all sorts of nasty stuff. Hormone-disrupting chemicals, heavy metals, and mitochondrial toxins are common in these products.

- Skin care: MyChelle brand, Annmarie Gianni brand, and The Spa Dr. brand.
- Soap: African Black soap or Dr. Bronner’s
- Perfume and cologne: Essential oil blends are the best choice here. (Again, let me emphasize that conventional perfumes and colognes do disrupt your hormone balance). For pre-made essential oil blends that smell amazing, try Aura Cacia brand or doTerra.

- Makeup: Physicians Formula Organic Wear and bareMinerals brands

- Shampoo: Acure Organics

- Body wash: African Black Soap, Acure Organics or Dr. Bronner’s

- Lotion: Acure Organics