

Control Your Mitochondria or They Will Control You

Mitochondria are small organelles within cells, popularly known as the powerhouses of the cell, since their main function is to burn energy. With a few exceptions, such as red blood cells, every cell in the body contains hundreds or thousands of mitochondria, and they are crucially important in aging. That's why you must control your mitochondria or they will control you.

Aging mitochondria

Mitochondria are so important to aging that there's an entire theory called [the mitochondrial theory of aging](#).

As cells age, so do mitochondria, and they decline in capacity to make energy, generating reactive oxygen species (ROS, or free radicals), which cause self-damage as well as damage to the cells within which they reside.

Mitochondrial quality control is crucial to fighting aging.

Mitochondrial quality control

Perhaps the most crucial mitochondrial quality control process is [autophagy](#), the cellular self-cleansing process that rids cells of junk. When mitochondria are subject to this process, it's known as mitophagy. Mitochondria that are past their expiration date, that are inefficient and generating large amounts of free radicals, are sent through the meat grinder of autophagy, their constituents broken down and sent for recycling, and new mitochondria are built to replace them.

The decline in autophagy is one of the hallmarks of aging. An aging organism can [no longer increase autophagy to the extent that it could when young](#). Autophagy is necessary because of the importance of maintaining clean cells. With aging, cells become cluttered and inefficient, and this is one of the crucial differences between young and old cells. Aging takes place most of

all at the cellular level; aging cells mean an aging body. Maintenance of highly functional mitochondria is a characteristic of youth.

Insulin resistance is a characteristic of aging, and [people with it have poorly functioning mitochondria](#).

Older people have lower exercise capacity and in general a lot less energy than young people. This is due in large part to declining mitochondrial function.

How to increase mitochondrial function

As you get older, and if you do nothing to intervene in the aging process, mitochondria decline in function and cause aging. In essence, if you don't control your mitochondria, they will control you. Fortunately, there are a number of things you can do about this; most of them require some discipline.

Exercise

Exercise robustly increases mitochondrial function. A new study found that high-intensity interval training [robustly increased the ability of mitochondria to generate energy](#), 69% greater in older people, and 49% in younger. The older people had a greater deficit in function, hence they had a greater improvement.

Intensity is a crucial component of exercise in every way, but especially so regarding improvement in mitochondria.

The study found that resistance training did not improve mitochondrial function (though it did improve insulin sensitivity), but this is likely because of training that wasn't intense enough. Other studies have found [increases in mitochondrial proteins involved in energy production in resistance training](#). That's one reason for strength training I recommend [high-intensity training](#). Nonetheless, if you lift weights, it may be beneficial to add a component of [high-intensity interval training](#).

Intermittent fasting

Nothing increases the process of autophagy more than going without food. [Intermittent fasting increases the quality of mitochondria](#), partly through this mechanism.

The cellular and molecular effects of intermittent fasting are [similar to those of regular exercise](#), which suggests that mechanisms are similar.

Resveratrol and other phytochemicals

[Resveratrol increases lifespan in mice on a diabetes-inducing diet](#). One of the ways that it works is by increasing mitochondrial [quantity](#) and [quality](#).

EGCG, from green tea extract, also [improves mitochondrial quality](#).

Iron

[The accumulation of iron causes mitochondria to become dysfunctional](#), and this is critical in aging. [Controlling iron levels is critical to fighting aging](#).

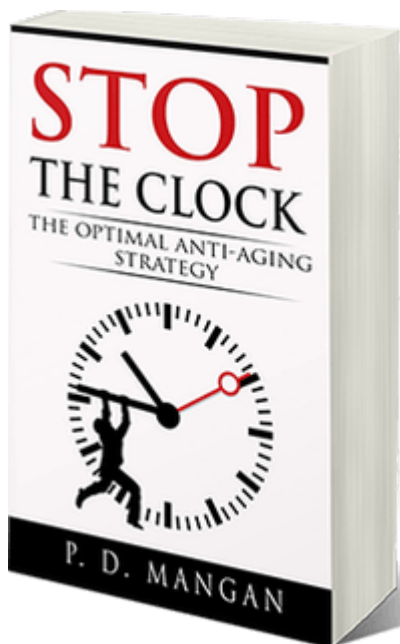
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Aging is characterized by a loss of mitochondria quality and quantity, and there's every reason to think these are critical to the aging process.

A couch-potato life, with no hormetic stressors, leads to poor mitochondria, and subsequent aging and disease.

Therefore you must control your mitochondria or they will control you.

For more on how to control aging, the best few bucks you'll ever spend are on my book, [Stop the Clock](#).



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