



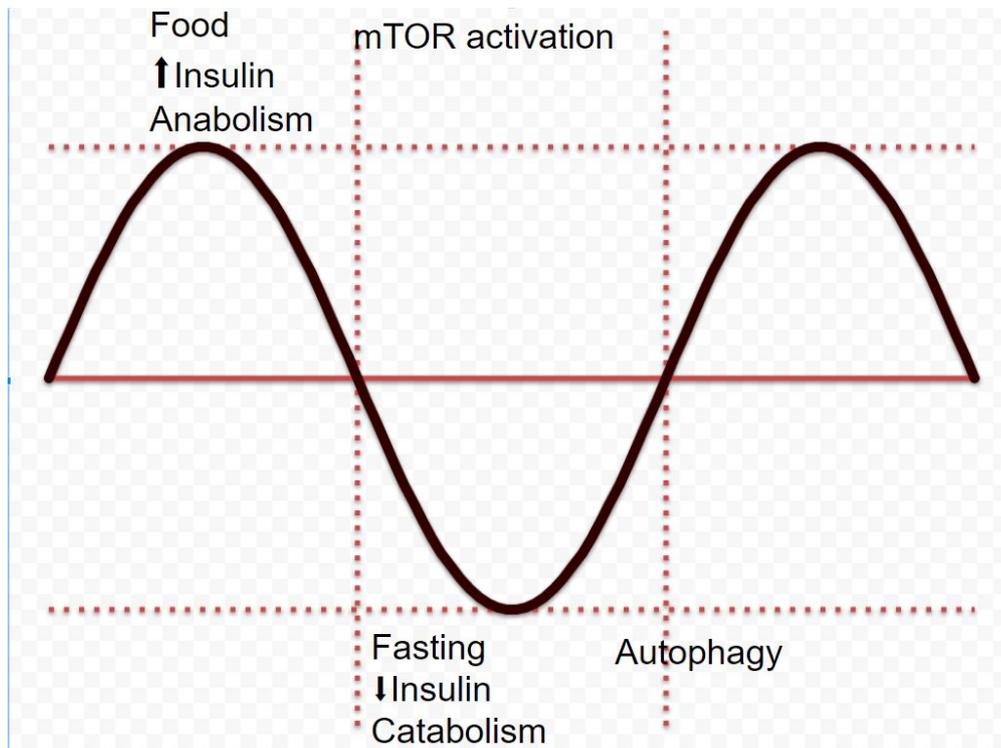
Why Stress and Recovery Are Essential for Long Life

Stress and recovery are essential for long life and good health. While we usually think of “stress” as something bad, that really only applies to chronic stress. Certain acute stresses lead to better health and life extension.

No stress and too much comfort shorten life.

The rhythm of stress and recovery

The graph below (which I made) shows a natural daily rhythm that the body cycles through.



This rhythm is largely driven by food and by fasting.

When we eat, insulin increases, which leads to mTOR activation and anabolism.

A feature of muscle that most don't realize is that it constantly builds up and breaks down, and this is normal and desirable.

Eat protein and other nutrients, and muscle protein synthesis increases. When fasting, muscle breaks down to supply necessary amino acids to the rest of the body. Leucine, a BCAA, is the master regulator of synthesis.

mTOR is a nutrient-sensing cellular mechanism that promotes both growth and aging.

A prominent theory of aging (that of Mikhail Blagosklonny) holds that over-activation of mTOR is the primary driver of aging.

Yet mTOR is also necessary for good health. What seems to be happening in aging is *chronic* over-activation, not sporadic activation. Although it is certainly possible that *any* activation of mTOR promotes aging in some manner.

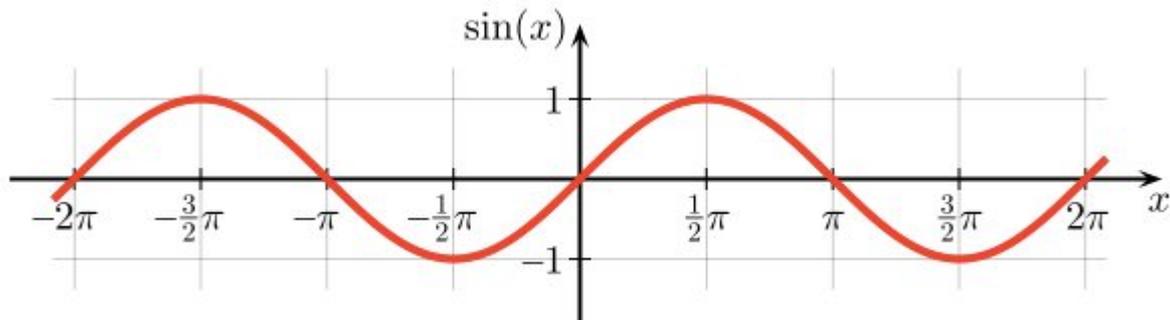
When fasting, the absence of nutrients decreases insulin, de-activates mTOR, and promotes autophagy, the cellular self-cleansing process that rids our cells of junk and keeps them youthful. A build-up of cellular junk occurs in aging due to decreased autophagy as well as the accumulation of non-degradable [lipofuscin, leading to the "garbage catastrophe of aging"](#).

Aging flattens the wave

Besides eating and fasting, longer term processes affect the shape of the sine wave above.

Aging is perhaps the most important.

As we get older, the daily rhythm starts to look like the one below, flatter than when youthful.



The peaks are lower, so muscle protein synthesis doesn't happen at the same rate as previously, when young.

That leads to [the muscle loss seen in aging](#).

The valleys are higher, so autophagy is not induced at as high a rate as when young. That leads to accumulation of cellular junk, which in turn leads to poor cell function and the susceptibility to illness and breakdown that virtually defines the process of aging.

Insulin becomes chronically higher in aging, which in turn activates mTOR and promotes even more aging in a vicious cycle.

The graph below ([source](#)) shows how these factors interrelate. Insulin activates mTOR, which inhibits autophagy. (This makes perfect sense, since when you take in nutrients, you want to build, not break down.)

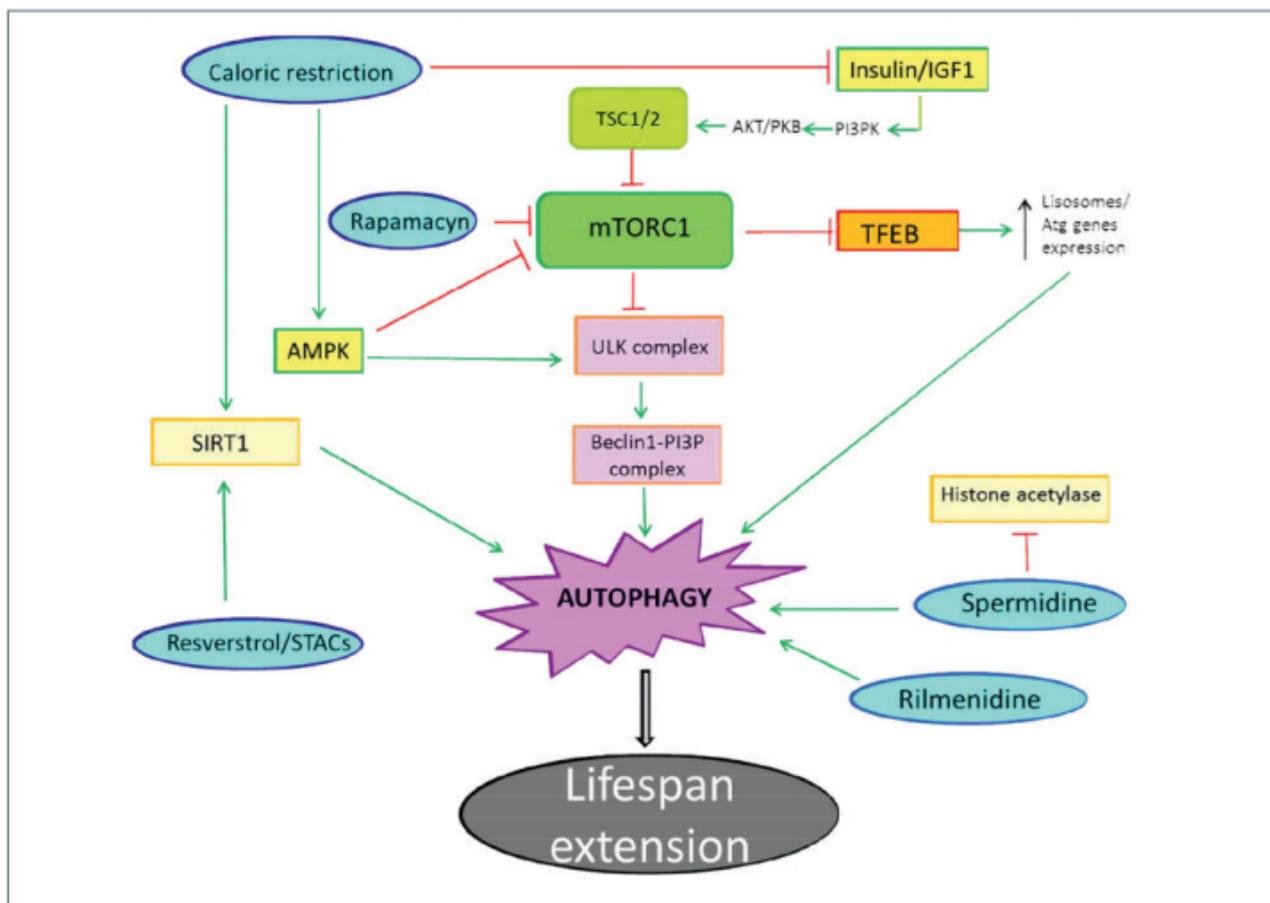


Figure 2. Signaling pathways and stress responses converging on autophagy to regulate lifespan. Insulin/IGF-1 and TORC1 pathways inhibition, or SIRT1 and AMPK pathways activation increase lifespan through autophagy induction in a wide variety of species. Under basal conditions mTORC1 inhibits autophagy by associating with the ULK1/Atg13/FIP200 complex and inhibiting it. Under nutrient deprivation or low energy, different signaling pathways inactivate TOR kinase activity, thus inducing autophagy through the release and activation of the ULK1/Atg13/FIP200 complex. The interventions targeting different pathways which contribute to aging regulation by autophagy stimulation and result in improved health and enhanced lifespan, are shown. Green arrows: activating inputs; red bars: inhibitory interactions; light blue boxes: anti-aging interventions stimulating autophagy through activation/suppression of different signaling pathways which regulate longevity.

The importance of stress and recovery

Interventions that stress the body generally lead to deactivation of mTOR, lower insulin, catabolism, and increased autophagy.

Interventions that allow recovery generally lead to activation of mTOR, increased insulin, anabolism, and decreased autophagy.

Both are necessary.

But in the modern world, recovery and comfort dominate.

If we are always eating and resting, we never apply the necessary stress to our bodies.

Consequently, without stress, it deteriorates.

Obesity soundly represses autophagy and therefore activates mTOR and promotes aging. Or as I like to say, [obesity is an archetype of aging.](#)

It's an open question [how much of aging is just people letting themselves go](#). Certainly, animals age, and while aging is intrinsic to almost every organism, a decline in physical function leads to more aging in a cycle of reinforcement.

For example, mainstream thinking has it that insulin resistance increases with age, and that [it's closely connected to aging](#). Yet when abdominal fat is controlled for, [aging explains only a small fraction of the variance in insulin sensitivity](#).

These results suggest that insulin resistance is more closely associated with abdominal adiposity than with age.

Therefore, you can fight aging by maintaining good insulin sensitivity. (Article coming soon on this.)

To our point here, *how much of aging is due to too much comfort and not enough stress?*

It seems to be a given that as people age, they feel they "deserve" their comfort and lack of exertion. (Not to mention [lack of ambition](#).) Psychological feelings of entitlement (for lack of a better word) could accelerate aging in this manner.

If we stress ourselves often, allowing for full recovery, we have a means of counteracting aging.

How to stress and recover

The means of stress are many and have been discussed on this site many times.

- Exercise. Resistance training and HIIT are the most effective for both activating stress response mechanisms as well as ramping up muscle anabolism.
- Intermittent fasting. By going without food, we decrease insulin and mTOR activation, and increase autophagy. This stress helps keep cells in fine tune and facilitates the proper working of our physiology.
- Other stresses include cold showers, sauna bathing, solar radiation, AMPK activators like metformin and resveratrol, other phytochemicals such as in tea and coffee. Even occasional loss of sleep can cause a beneficial stress, relieving depression.

The means of recovery:

- Food. Eating puts us into recovery and anabolic mode. Quality of food is important, such as adequate protein.
- Sleep and rest.

In our modern world, the emphasis is on recovery. We eat constantly and never get into a properly fasted state, then we sit on our backsides watching Netflix.

Too much stress is harmful of course, since the principle of [hormesis](#) requires a low-dose of a stress or toxin. Too much exercise, too much cold exposure, etc, can be harmful. However, those limits are reached by few.

Some form of stress should be practiced daily, in my opinion.

PS: If you need to lose weight and you want to save yourself years of poor results with bad information, I've put everything in a simple guide for you. [The World's Simplest Fat-Loss Plan.](#)

