

How to Stay Fit for Life

Analysis by [Dr. Joseph Mercola](#)

✓ Fact Checked

January 22, 2023

STORY AT-A-GLANCE

- › It is rarely too late to start resistance training; you can build muscle mass well after age 60. In 2022, I set a new personal record in the leg press for 600 pounds, far better than the 400-pound deadlift I did the year before
- › Sarcopenia – age-related muscle loss – threatens a healthy lifespan. Skeletal muscle not only manages physical activity, but also plays a major role in metabolism, circulation and cognition
- › Skeletal muscle acts as endocrine organ secreting myokines and transcription factors into the bloodstream, thereby regulating the function of other organs. It also has immune regulatory properties
- › The loss of muscle mass is thought to be a primary driver of insulin resistance in older adults. Declining muscle strength and reduced physical activity also contribute to metabolic dysfunction
- › In order to gain muscle mass though one needs a critical to eat enough protein. A minimum is about 1.2 grams per kilogram of body weight (0.54 grams/pound) per day. Athletes and the elderly could probably benefit from going up from that level to about 1.6 grams/kilogram (0.71 grams/pound)

This may be one of the most important articles I've ever written with respect to helping you understand how important resistance exercise is to not only slowing down the aging process but improving your overall metabolic health. We know this is important because

studies have shown that over 75% of those over 65 do not exercise enough to stay healthy.

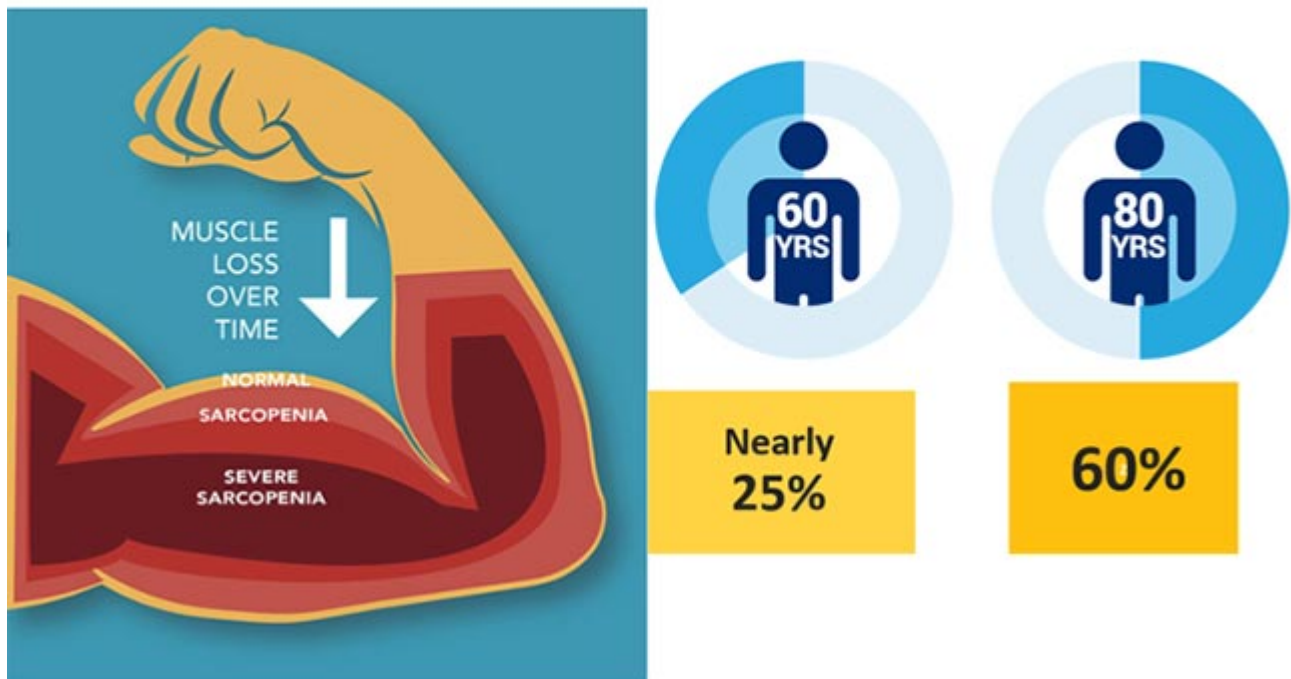
But, the key is to understand the type of exercise that will give you the greatest benefit for the time invested. If we had to engage in hard physical labor for our work we wouldn't need to exercise. Formal exercise is only needed because most of us have long ago stopped engaging in manual labor. Modern society has allowed us to obtain food and shelter with relatively little effort. So, we need exercise to compensate for this if we hope to optimize our physical health.

I want to share my experience with you so you don't make the same mistakes I did 50 year ago. To me the evidence is crystal clear: As you age you need to engage in some type of resistance training to compensate for the degeneration that typically accompanies aging and decreased physical activity. You can do cardio if you have the time, but not at the expense of building lean muscle mass. This is largely because aging accelerates muscle loss.

Understanding the Hazards of Sarcopenia

The medical term for age-related muscle loss is sarcopenia.¹ Sarcopenia is derived from two Greek words: sarx (flesh) and penia (poverty).² So, as you get older you will invariably start losing muscle mass, and if you don't engage in resistance exercises, you will likely suffer metabolic diseases as well.

Sarcopenia



An estimated 25% of 60-year-olds have sarcopenia, and nearly two-thirds of those 80 years and older have lost serious amounts of muscle mass, which threatens a healthy lifespan and cuts down on your independence and quality of life.^{3,4} Sarcopenia leads to many functional limitations, including difficulties in walking, climbing stairs and carrying objects.⁵ The penalties of this functional decline include falls, disability, institutionalization⁶ and even death.⁷

One of the reasons I'm committed to lifelong exercise is because both of my parents died from frailty, and I'm determined to avoid sarcopenia, which took them prematurely. This was a powerful motivation for me to deeply study frailty so I could avoid their fate.

With society aging worldwide, the prevalence of sarcopenia increases the urgent need to establish prevention and intervention strategies. The U.S. Centers for Disease Control and Prevention now recognizes sarcopenia as an independently reportable medical condition.⁸

Skeletal muscles not only function to generate force and movement, but also play a major role in your metabolism, circulation and cognition, as seen in the following figure. Skeletal muscles also serve an important endocrine function. They secrete special cytokines (i.e., myokines) and transcription factors into the bloodstream, thereby regulating the function of other organs. It's a metabolically active tissue with an important role in the maintenance of metabolic homeostasis.

Muscle Functions



Physical

- Generates force and power
- Drives Movement
- Enables function/activity



Metabolism

- Primary site of insulin mediated glucose disposal
- Largest reservoir of glycogen in the body



Resilience

- Strength, mobility and endurance to reduce frailty
- Adaptive capacity for multiple disease states

Sarcopenia Is a Major Driver of Insulin Resistance and Disease

Skeletal muscle is the most abundant tissue in your body, comprising 40%⁹ to 55%¹⁰ of your body mass, and is the primary sink of insulin-mediated glucose disposal. Muscle is also the major site for insulin-stimulated glucose uptake, as well as the main energy consumer of fat.¹¹ After meals, about 80% of glucose is deposited in your skeletal muscle.^{12,13}

The loss of muscle mass with advancing age is thought to be a primary driver of insulin resistance in older adults.¹⁴ Again, this is because muscle is the major tissue where

insulin causes glucose to be absorbed.

But it doesn't end there. Remember, muscle makes up nearly half of your body's tissues, so once your body runs out of sugar in the form of glycogen, it uses fat, especially if you are metabolically flexible. So, muscle is also the main energy user of fat in your body.¹⁵ The declining muscle strength and progressive mobility impairment with age also tends to reduce daily physical activity, which also contributes to metabolic dysfunction.^{16,17}

The loss of resilience as a result of sarcopenia is underappreciated as a major factor in the ability to recover from life's inevitable challenges. It is clear that elderly with low muscle mass experience delayed recovery,^{18,19} and have higher rates of complications and infections following surgery,²⁰ greater drug toxicity²¹ and higher disease-specific and all-cause mortality.²²

Sarcopenia also predicts both the risk for community-acquired pneumonia in the elderly,²³ as well as 90-day mortality in patients suffering from aspiration pneumonia.²⁴

Muscle Play a Role in Your Immune Function Too

Muscle is increasingly recognized as an organ with immune regulatory properties. As such, skeletal muscle cells modulate immune function by signaling through different soluble factors, cell surface molecules or cell-to-cell interactions.²⁵ It is also speculated that sarcopenia contributes to immunosenescence – the gradual deterioration of your immune system – which is a leading cause of death in the elderly.²⁶

Additionally, recent reviews found strong evidence that frailty due to sarcopenia²⁷ is a risk factor for adverse outcomes, such as longer hospital stay, functional decline at discharge and both in-hospital and medium, lower quality of life,²⁸ and long-term mortality.²⁹

My Strategy and Recommendation to Combat Sarcopenia

So, what can we do about this progressive decline in muscle loss that sets you up for frailty and metabolic catastrophe? Why, exercise, of course. But here's a little-known fact: Despite the well-known benefits of resistance training, less than 10% of those under the age of 75 in the United States participate in muscle-strengthening activities.

I believe one of the main reasons for this low rate of participation is that over half of those who do exercise engage in conventional resistance training end up getting injured. Another reason is that conventional strength training is considerably less effective in healthy older adults than in young adults.

This blunted anabolic response to exercise training in older individuals³⁰ is likely a result of the age-related decline in muscle fiber perfusion.³¹

This has been known for a long time. Seventeenth century physician Dr. Thomas Sydenham, who is known as the "English Hippocrates," recognized nearly 400 years ago that vascular health and aging are interdependent and inversely related.³² His famous quote is: "A man is as old as his arteries."

Microcirculation is the term used to describe blood flow through the capillaries. The main function of the microcirculation is the delivery of oxygen and nutrients to tissues while removing CO₂, metabolic debris and toxins. Researchers believe this is related to a decrease in muscle fiber microcirculation of Type II muscle fibers and their associated stem cells.

Studies have shown that Type II muscle fiber-associated stem cells are located at a greater distance to their nearest capillary in older compared with younger men.³³ There are a large number of circulating growth factors that are regulators of stem cell function³⁴ and the delivery of these signals to activate your muscle stem cells and promote muscle growth relies on how close they are to the capillaries.

Once your microcirculation becomes compromised with age, Type II muscle fibers and their associated stem cells will be unable to receive enough nutrients and oxygen. Thankfully, there is a solution to this dilemma, and it is called blood flow restriction (BFR) or KAATSU in Japan, which is where it originated.

How I Radically Changed My Exercise and Lean Muscle

Now, I am no stranger to exercise. I have been exercising since 1968, which is 54 years. The problem is that the first 43 years were exclusively cardio, and in my case long distance running. I like to compete, so I got relatively decent and was eventually able to run a 2:50 marathon, which was good enough back then to get me on the post-graduate University of Chicago Track Club.

Unfortunately, I didn't realize that while cardiovascular exercise can lower your risk of heart disease, it is a highly catabolic activity and will actually lower your ability to build muscle. Below is a picture of me taken during my peak running condition. As you can see by the arrow, I had a "gigantic," 10.5-inch arm circumference.



Contrast that to the picture below, taken December 8, 2020, where my arm circumference is 15 inches. I had just finished doing a PR video for the deadlift at 370 pounds. The video (below) was posted to Instagram on the same date.

The blue plates are 45 pounds each; the black ones are the same width as the blue ones, but are plastic and are 25 pounds; and the bar is 50 pounds. My team wanted me to do a story on how I did this to, hopefully, inspire you to similar, if not better, levels of strength.

I'm very proud to say that I've come even further since then and, now, even approaching 70, I've been able to regularly set personal records with some of the lifts that I'm doing, and have deadlifted four plates, which is 405 pounds.



Watch Me Leg Press 600 Pounds

Without doubt, building muscle is one of the most important strategies to improve and safeguard your health, especially as you age. You need protein reserves to survive

serious disease, and most of your protein is stored in muscle. If you have very little muscle, you're going to pass away prematurely because you have no amino acid reserves.

As mentioned, your muscle is also a primary regulator of your metabolism. It's a primary site for glucose disposal because of the GLUT4 insulin receptors embedded in the muscle cell membranes. These receptors lower your glucose levels after a meal and decrease your risk for diabetes. It also interfaces with your immune system and helps optimize it.

If you take away one tip from this article, let it be this – it is rarely too late to start resistance training. You can build muscle mass after 60, which is about when I started and, earlier in 2022, as you can see in the video above, I set a new personal record in the leg press for 600 pounds, a significant improvement over the 400-pound deadlift I did in 2021.

How did I do it? That's the focus of this article, and the great news is that virtually anyone can use this strategy, even if you're older, like me, or already a bit frail, or have previously experienced exercise injuries.

The BEST Strategy I Know of to Increase Muscle Size

There are loads of ways to increase your muscle mass but they mostly involve moving, pushing or pulling heavy weights or resistance bands. The problem with this strategy is that if you are not in good shape, and especially if you are elderly, there is a very high likelihood that you will get injured. In most cases, it is not if you will get injured but when.

The answer to this problem is an exercise strategy known as BFR or KAATSU. As the name implies, BFR involves modifying the arterial inflow and venous outflow while you're working the muscle by placing an inflatable band around the extremity.³⁵ It is not like a tourniquet that stops all your blood flow, which is dangerous.

BFR was developed by Dr. Yoshiaki Sato of Japan about 50 years ago. In Japan, where it's widely popular, it's known as KAATSU, meaning "training with added pressure."³⁶ However since Sato does not speak or write English, the first article published about it in the U.S. was about 25 years ago.³⁷

Conventional resistance training typically uses resistance at 70% to 85% of your one-rep max, i.e., the maximum amount of weight you can lift only one time. Since this weight is relatively heavy and close to your limit, injuries are almost guaranteed.

BFR is different, as it is a low-intensity resistance training, using weights that are just 20% to 35% of your one-rep max. With weights this light, your risk of injury is largely eliminated. In many elderly and frail individuals, weights of just 1 or 2 pounds, or no weight other than your body, are all that is needed to achieve the benefits.

How BFR Works

BFR's ability to achieve such remarkable physiological benefits is directly related to slowing venous blood flow from the muscle group being engaged and creating a relatively hypoxic environment or low oxygen pressures in the exercising muscle. Venous flow moderation is optimally achieved by wrapping the extremity being exercised with an inflatable cuff or band.

The band needs to be tight enough to slow venous return to the heart, allowing venous blood to "pool" in the region of the limb that is being exercised, while loose enough to allow arterial blood to flow through.

With very light exercise, and in about 15 to 20 minutes, you get an exhaustive workout that sends a signal to your brain that says, "Hey, I've done something really hard here — you better help me recover and adapt to it."

Your brain then sends out hormonal responses that cause your muscles and blood vessels to grow. Most would think that such light weights would be insufficient to provide any muscle strength improvements, but studies show a 36% to 40% increase in muscle strength after only 12 weeks, depending on your load and health.³⁸



BFR Mimics Heavy Weight Training Without Any of the Risks

BFR training is frequently misunderstood as simply a conventional resistance training program with the addition of resistance bands. Nothing could be further from the truth.

Because the exercise is done with such low weights, there's far less muscle fiber trauma and damage, especially relative to conventional strength training. This means you are able to recover much quicker, so you

don't have to dig yourself out of a hole the next few days. In most cases, you can exercise different body parts nearly every day and rapidly attain the metabolic and physical benefits.

To understand the mechanism of BFR you need to know that you have two basic types of muscle fibers. First you have slow-twitch oxidative (Type I) fibers designed for low-intensity long-lasting contractions. Secondly, you have fast-twitch glycolytic (Type II) fibers designed for high-intensity short-duration contractions. When you lose muscle, it typically occurs as a reduction in Type II muscle fibers.

Type 1 Muscle Fiber



1. Low anaerobic power
2. Take more time to get fatigued

Type 2 Muscle Fiber



1. High Anaerobic Power
2. get fatigued faster

If you are going to increase muscle mass and strength in anyone, but especially the elderly, it is important to activate Type II muscle fibers during training, since these fibers have been shown to be far more responsive to growing muscle than Type I fibers³⁹ and are generally much larger.

Weight training done at low weights will not activate Type II fibers – unless it's done with BFR. Type I fibers are relatively more sensitive than type II fibers to hypoxia (low blood oxygen), as they have a greater oxygen consumption at rest compared to Type II fibers.⁴⁰ BFR training takes advantage of this difference. Producing a relatively hypoxic environment in your muscles⁴¹ causes premature fatigue of the Type I fibers, thus forcing your body to rely on Type II fibers to continue the exercise.

At the same time, you're also activating their associated muscle stem cells. This is likely one of the main mechanisms by which BFR can trigger muscle growth and prevent or prevent or treat sarcopenia. Simply moving light weights with high repetition without BFR will not engage Type II fibers because there is plenty of oxygen for the Type I fibers to work. Hence, the fast-twitch Type II fibers just aren't called into action.

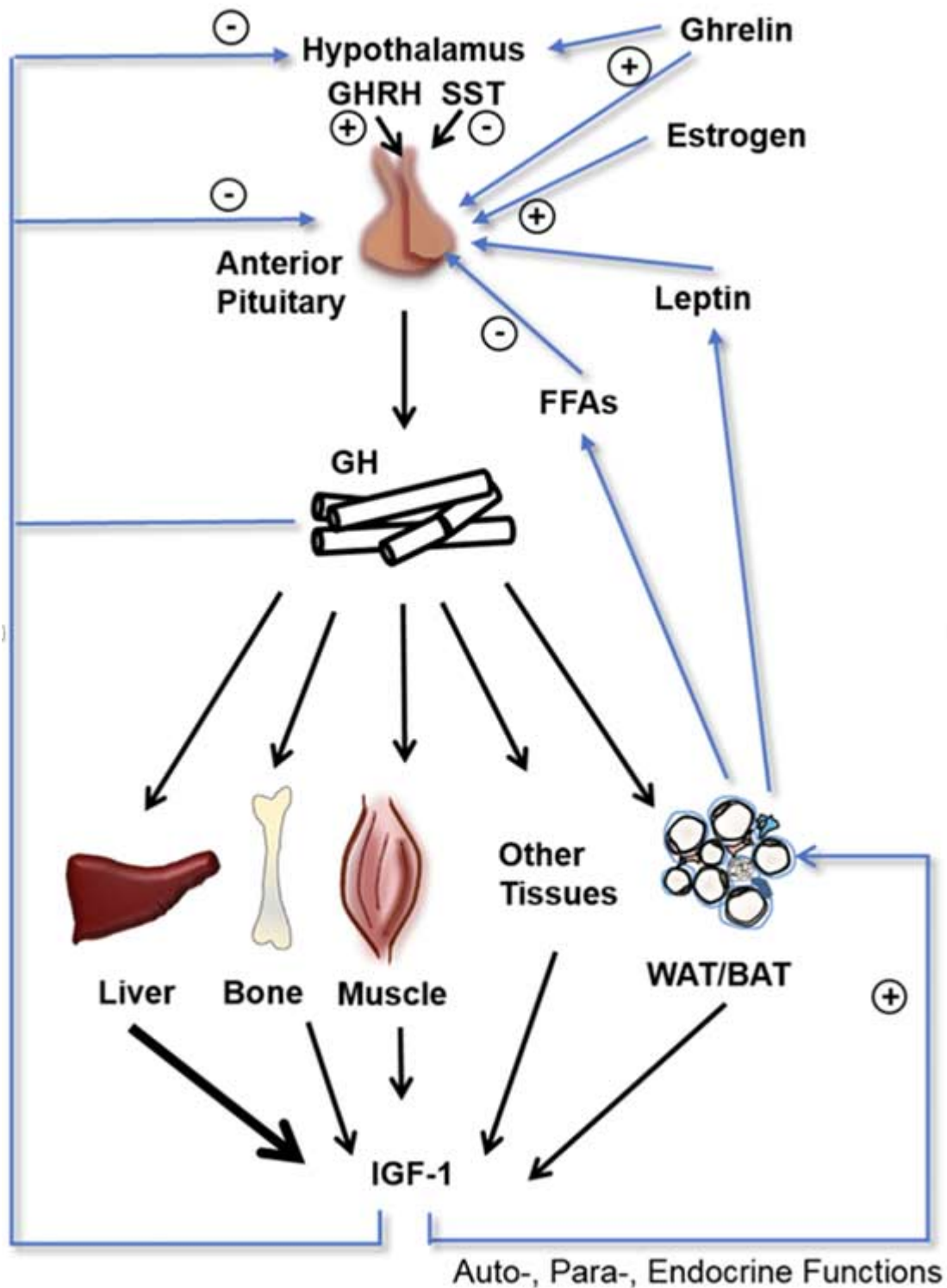
How BFR Affects Your Muscles and Overall Health

When you exercise and activate your Type 2 fibers with BFR, your muscles will generate a waste product called lactic acid or lactate, which is responsible for much of the metabolic magic. Activating Type 2 fibers also lowers the pH of the muscles. This is not because of lactic acid, but more related to the release of extra protons released in generating energy.⁴²

Both lactate and proton accumulation are potent stimulators of growth hormone and insulin-like growth factor (IGF-1), which in turn leads to muscle growth.⁴³ IGF-1 is a hormone that helps manage growth hormone (GH) in the body. It's typically made by your liver, which is the largest contributor to IGF-1 circulating in your blood. However, when your liver secretes IGF-1, it will not act on those tissues that have capabilities of producing the hormone themselves, such as skeletal muscle.⁴⁴

Interestingly, it is not the circulating levels of IGF-1 in your blood that cause your muscles to grow but, rather, the IGF-1 produced by your muscles when engaged in exercises like BFR, as that's the key determinant for switching on the anabolic muscle building pathways.

While high levels of IGF-1 in your blood will inhibit autophagy and decrease your longevity,⁴⁵ this does not appear to be the case when you increase IGF-1 in your muscle using anaerobic exercises like BFR. This IGF-1 does not leak out into your blood to suppress autophagy.⁴⁶



BFR will not only will add solid muscle mass, but also significantly increase your strength and endurance while reducing your body fat. For most people who are not competitive athletes, it's really the only form of resistance training they need.

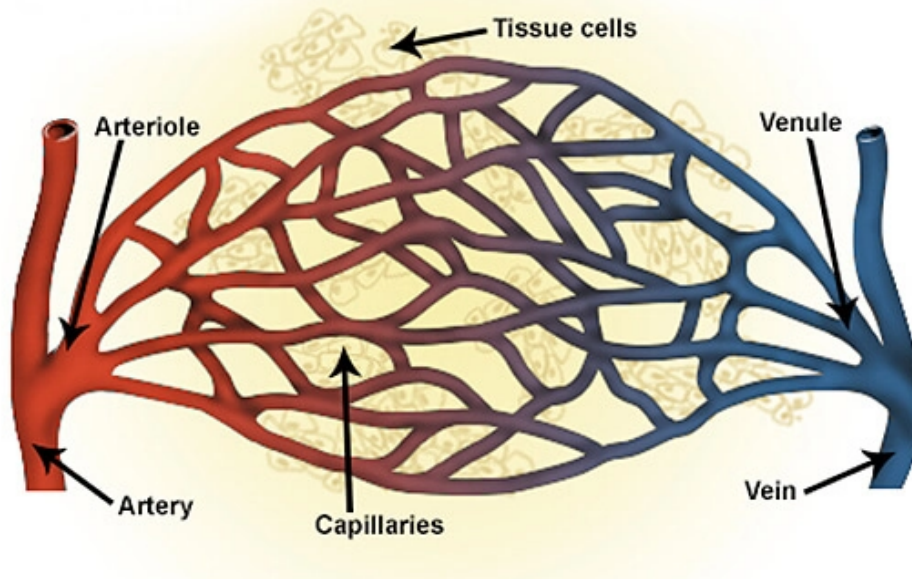
Competitive athletes also seem to benefit from BFR, but they would need to combine it with conventional strength training.⁴⁷ In short, BFR works on a very simple principle: It

tricks your body into believing that it's moving far heavier weights than you're actually using, and as a result generates compensatory metabolic responses, further detailed below.

Local and Systemic Effects of BFR

If you are elderly, what is really amazing is that your muscle growth with BFR is beyond what strength training with heavy weights can do. This is because you need good blood flow to your Type II muscle fiber stem cells, and as mentioned earlier, virtually everyone's microcirculation decreases with age.

So, even if you send the signal to grow by doing conventional strength training, it won't work as well if there isn't enough capillary supply to your Type II fiber stem cells. BFR increases your microcirculation, your capillaries and venules and arterioles that are associated with them (see image below), largely because your muscles are working in a hypoxic (low oxygen) environment.



Microcirculation

How BFR Increases Your Microcirculation

This low oxygen tension causes the release of hypoxia-inducible factor-1 alpha (HIF-1 alpha),⁴⁸ which in turn increases the hormone vascular endothelial growth factor (VEGF), which is one of the most powerful angiogenic signals in your body. It's an extremely potent pro-blood vessel building cytokine or myokine. VEGF will help repair damage that has occurred to your blood vessels, improve elasticity and make them far more resilient to damage and accidents.

BFR has been shown to raise VEGF levels by 410% in young adults.⁴⁹ Essentially it acts as "fertilizer" for growing new blood vessels and capillaries to your muscle stem cells. BFR training has been shown to increase muscle stem cells by 300% after eight days of training.⁵⁰

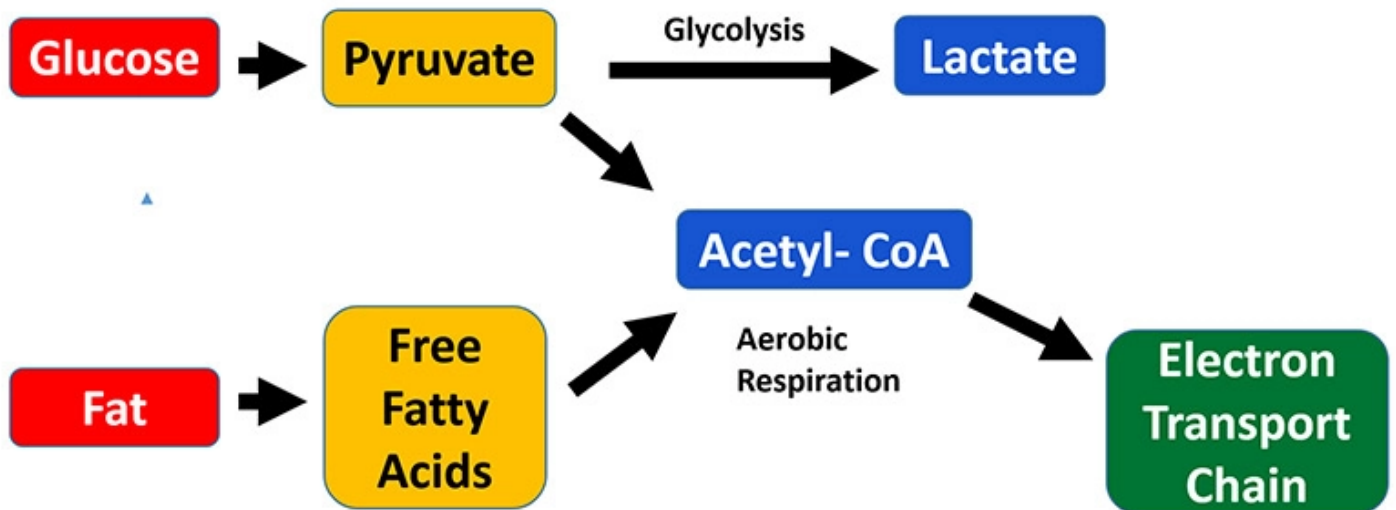
Here is the KEY point: The VEGF released by BFR is systemic and carried in your blood to your entire body. It just doesn't work on the limbs you are exercising. It increases blood vessel growth throughout your entire body, which seems to be the perfect antidote for Dr. Sydenham's theory that a man is old as his arteries.

In short, BFR will help aging men have the arteries of boys. VEGF also increases microcirculation in your brain and heart. In Japan, BFR is frequently used for stroke and cardiac rehab precisely for this purpose.

BFR also increases the production of the important regulatory free radical, nitric oxide (NO), which further contributes to an increase in VEGF.⁵¹ NO is an important signaling molecule produced at high levels in muscle by neuronal nitric oxide synthase (nNOS). BFR, by way of increasing NO, has been found to stimulate muscle satellite stem cells and proliferation.⁵²

There is a load of interest in NAD+, as it's a primary fuel for longevity proteins, and it becomes depleted as you age. A combination of BFR along with 50 milligrams of niacinamide per day will radically increase NAMPT, which is the rate limiting enzyme for NAD+. Honoring your circadian rhythm is also an important part of the equation.

The Benefits of Osmotic Pressure



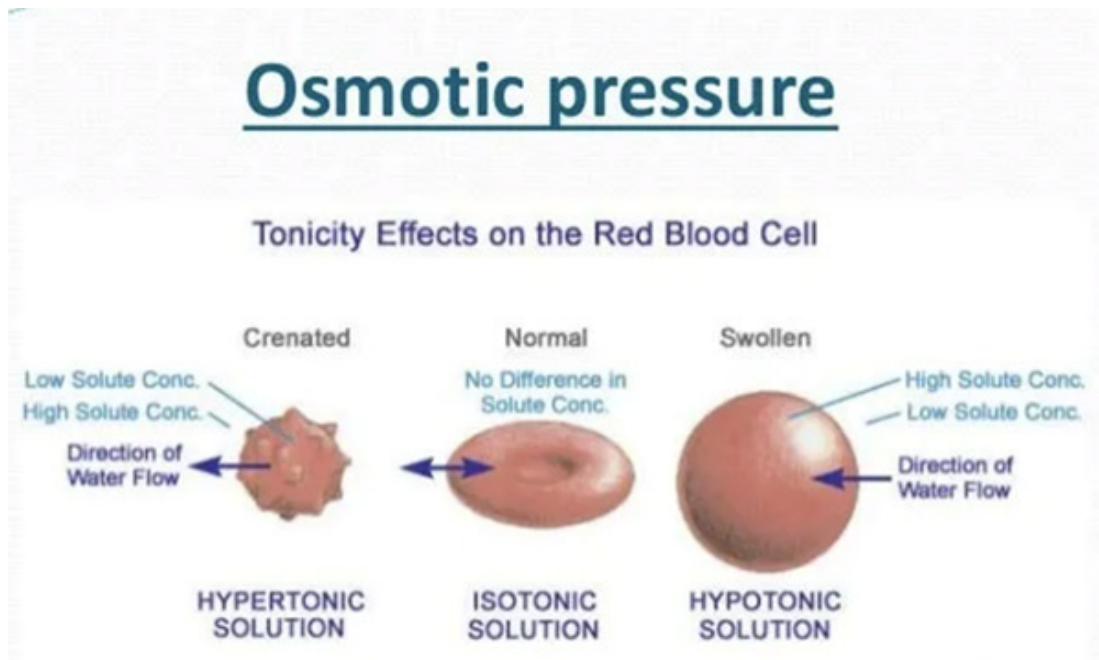
Metabolic stress, or the accumulation of metabolites during exercise, has been documented to be important for muscle growth.^{53,54,55} One of the most important metabolic stressors produced in BFR training is lactate, which I touched on earlier. The lactate released by the muscles is largely a result of Type II muscle fiber burning glucose into pyruvate and then converting pyruvate to lactate.

When you occlude the veins in BFR, you limit the venous blood flow return back to your heart, which allows the lactate to accumulate to high concentrations in your muscle,⁵⁶ where it creates an osmotic pressure differential that requires the influx of water to normalize.

As you can see by the figure below, osmotic pressure is the pressure that must be applied to a solution to halt the flow of solvent molecules through a semipermeable membrane (osmosis). It is determined by how many molecules are in the solution. The more molecules, the higher the osmotic pressure.

This flow of water into the muscle⁵⁷ contributes to intracellular swelling,⁵⁸ which creates an acute and measurable increase in the size of the muscle that is typically quite visually obvious.

The mechanical pressures created by this cell swelling also trigger the activation of Type II muscle fiber stem cells, which causes muscle growth and further increases muscle protein synthesis and decreases protein breakdown in your muscles.⁵⁹ So, the higher the lactate levels and swelling created with BFR training, the better the muscle-building results will be.



Interestingly, some of the lactate produced locally in your muscles actually diffuses into the bloodstream and crosses the blood brain barrier through monocarboxylate transporters (MCTs), and is utilized as fuel for the brain.^{60,61}

Similar to ketones, lactate can be an important brain fuel, as at high lactate concentrations, up to 60% of the brain's energy can come from lactate. Once the lactate reaches your brain – which occurs when you release the bands from your extremities – it increases brain derived neurotropic factor (BDNF),⁶² a member of brain growth factors that contributes to neuroplasticity and enhanced cognitive performance.^{63,64}

I first learned about BFR in 2017 at a Beverly Hills biohacking event. I've been using it nearly every day for at least an hour a day since then and have compiled a number of insights in that time. The main difference between KAATSU and BFR is the tool you're using. BFR can be done with restriction bands, but KAATSU uses a device that also provides intermittent and not just constant pressure.

From the start, I was really intrigued with the concept of BFR, so I purchased a KAATSU unit developed by Sato. In cycle mode, the KAATSU device produces 30 seconds of pressure followed by five seconds of no pressure, and does this for eight progressively increasing pressure steps per cycle. What this does is provide intermittent hypoxia, which catalyzes the steps I described above.

Since the intermittent hypoxia does not last more than 30 seconds, it does not damage your body, which can happen when you use the cheaper KAATSU bands or BRF bands that provide constant pressure. When I first started using BFR, I felt it was important enough to encourage people to get inexpensive bands that don't provide intermittent compression. The BFR bands were only \$15 and allowed far more people to access this powerful fitness strategy.

But after using the unit for five years, I have learned that when you use the cheap bands, or even KAATSU in the constant mode, you can get spastic large muscles. Using constant pressure increases the hypoxia time, and hence the lactic acid can build up to excessive levels. The only way to get the benefits without the downside is to avoid the constant mode and cheap bands.

This is why I only use the cycling KAATSU mode, not the constant mode or cheap bands, and why I now only recommend using the KAATSU intermittent hypoxia system, which is far safer and provides greater health benefits. Sato himself admits that the constant mode requires a lot of experience and know-how before it can be used safely.

The cycling mode, however, is safe to use for anyone. "Even someone in their 80s can do the KAATSU cycle mode without risks," he says. I also only recommend the C-3 model and do not recommend the B Bluetooth model.



For a limited time, you can get 10% off the KAATSU band by using this link: www.kaatsu.com/go/NVIC

Since I first started using KAATSU, I have gained about 25 pounds of muscle mass after the age of 65, which is extraordinarily hard to do. I am convinced that this is largely a result of using KAATSU and getting enough protein, as I do not take any drugs at all, let alone performance-enhancing drugs.

If I had only done strength training without KAATSU, I would likely not have gained anywhere near as much muscle mass. Again, this is largely due to older people having decreased microcirculation to feed the Type 2 muscle stem cells. You need the VEGF to increase blood supply to these cells, and conventional strength training does not do that very well.

Why I Only Recommend KAATSU Cycle Mode

The KAATSU set is ideal as it is far easier to dial in to the correct pressures. You also get the benefit of intermittent pressure automatically, without having to adjust the bands yourself. With the KAATSU system you can control the tightness in two ways.

The initial tightness is after you manually tighten the bands. This is the base pressure and typically around 10 to 25 mm/Hg for the arms and 15 to 35 mm/Hg for the legs, depending on your age, vascular elasticity and physical condition.

The inflation pressure is what you set the compressor to pump the cuff up to. This ranges from 80 to 400 mm/Hg for both the arms and legs. KAATSU is the only unit that will cycle the inflation of the bands on and off, which, again, is far healthier for your muscles. Sato notes (see video above):

"I gradually increase the pressure on each set, personally, doing up to eight sets. The first set has no effect, but my muscles pump up significantly from the sixth to eighth sets. If you do that for two or three circuits, the KAATSU cycle mode will have the same effect as the KAATSU constant mode. Therefore, I recommend the KAATSU cycle mode to the general public."

How to Determine Your Ideal Level of Resistance

Instead of using heavy weights that can increase your risk of injury during conventional strength training, BFR requires just 20% to 33% of the resistance used in conventional resistance training, which makes it much safer for everyone. This light weight is then

combined with a high volume of repetitions while externally applied compression mildly restricts blood flow to the active skeletal muscles in the legs or arms.⁶⁵



As for weight, your goal is to find the "sweet" spot. If you are elderly or have not been exercising regularly, this may mean no weights at all.

Ideally, you would have access to a variety of progressively increasing resistance movements to choose from, including body weight exercises. You typically won't need to go higher than 25 pounds, though.

Once you have access to the weights, you can find the heaviest weight you can do for just one repetition of your planned exercise. This is your one-rep max (1RM).

Then you divide that weight by five (20%), four (25%) or three (33%). For example, if your max weight for a bicep curl is 25 pounds, you would select a 5-pound dumbbell to start.

If you don't know your one-rep maximum, then it is always better to start too low, especially if this is your first time, as your tissues will need time to adapt to these pressures and movements. Eventually you will want to increase your weight so you notice the following signs during your KAATSU session.

Signs That You Are Using the Correct Weight

1. You are sweating profusely. In fact, you should be sweating so much that you need a towel.
2. Your heart rate and breathing can significantly increase, especially if you do intense BFR or any kind of vigorous aerobic exercise.

These two signs are an indication that you have activated your sympathetic nervous system by firing your Type II muscle fibers. This is because properly performed BFR is a high intensity exercise that will exhaust your Type I muscle fibers and activate your Type II fibers.

You can also measure the circumference of your limb before and after the exercise. You should notice an increase of at least one-half inch and possibly 1 inch or more — or, alternatively, the muscle will most certainly feel tighter and appear more toned.

Another great indication is that you will be able to do 30 reps the first set and then 15 to 20 reps the next and, most likely, are unable to do five to 10 reps in the last set because you are in muscle failure. It is important, though, not to fool yourself and stop just because it is hard. Muscle failure means that you are unable to do another rep if your life depended on it.

Unless you are just starting (see warning box below), it is best to start by limiting your weight to only 20% of your 1RM and build up from there. By starting at a lighter weight, it will give your body a chance to adjust to BFR and avoid potential injuries.

An additional benefit is that if you stick with lighter weights you can train more frequently because you won't cause as much muscle damage. For those interested in greater strength or muscle gains, you can increase to one-quarter and then to one-third the weight of your 1RM. If you are doing the exercises correctly, it will likely take you about three months to progress up to 33% of your 1RM. There is no need to go any higher than this.

If you don't know your 1RM, then all you have to do is pick a weight you believe you can easily do 30 reps with and start there. If you can easily do all three sets at that weight, then it's clearly too low a weight and you would benefit from increasing the resistance, especially if you don't notice an increase of at least one-half inch in the circumference of your biceps after the exercise.

Conversely, if you are unable to complete 20 repetitions on your first set, the resistance is likely too high and needs to be decreased.

! WARNING FOR FIRST-TIME USERS

The only exception to these weight recommendations and initial pressure of the bands is when you are first starting out. It is important to realize that your tissues need time to adjust to BFR training. For the first session, you want to start with a light pressure, likely under 40%, and use only 10% of your 1RM. Then over the next two sessions increase to the minimum recommendations.

Important: You Need to Push Hard to Get the Benefits



It is important to recognize that the level of intensity you use is key. Muscle growth is highly dependent on metabolic factors, and training sets are ideally done to close to failure to achieve this.^{66,67}

The number of repetitions completed during a training session is less important to cause long term changes in hypertrophy and strength than doing repetitions close to failure, which likely causes greater metabolic stress.

Perceived exertion is a major element here. You really need to push hard to muscle failure. This is a very subjective determination, but I hope the featured videos will give you an idea of the amount of intensity and effort one needs to put into this short exercise.

You can also notice if you are sweating and you are out of breath. Since BFR is a high intensity exercise and stimulates your sympathetic nervous system if done properly, this

is precisely what you should be experiencing when you do BFR training.

A recent study in the elderly showed that physical weakness in aging may be due, at least in part, to impairments in brain and nerve function, rather than changes in the muscles themselves.⁶⁸

The researchers did the study by asking participants to push to failure and once they said they had, they stimulated the muscle electrically and were still able to get the muscle to contract, which indicated that the muscle was not at full failure. In fact, in most cases the muscle was still able to contract about 25% more.

If you are unable to push close to failure, you will not receive the maximum benefits possible from BFR. Also, shorter recovery periods between exercises and sets will heighten the metabolic stimulus to enhance your body's ability to build muscle and strength.⁶⁹

Remember, you can start slowly and work your way up over time. Building muscle is a marathon, not a sprint. This is especially important if you are elderly or if you have been mostly sedentary; you likely will not need to use any weights.

You can start with just the weight of your body and gradually progress to 1- and 2-pound weights. But if you really are interested in triggering the benefits of reversing sarcopenia, then it is key to push hard – otherwise you will not achieve all the wonderful metabolic benefits that BFR has to offer you.

General KAATSU Workout Guidance

Although you can adapt KAATSU training to many types of resistance training, including machines, it seems the ideal way to implement it is by using simple dumbbells. Here's some general workout guidance when using KAATSU.

Number of repetitions in each set:

- 1st set = 30 reps with 10 to 15 seconds' rest for arms and 20- 30 seconds' rest for legs
- 2nd set = 20 to 30 reps with 10 to 15 seconds' rest for arms and 20- 30seconds' rest for legs
- 3rd set = 10 to 20 reps with 10 to 15 seconds' rest for arms and 20- 30seconds' rest for legs
- 4th set = 1 to 10 reps with 10 to 15 seconds' rest for arms and 20- 30seconds' rest for legs and 60 seconds maximum before moving to next exercise

Typically, upon starting KAATSU, you'll notice a high perceived degree of difficulty. However, over a few weeks this perception of difficulty dampens as adaptation to training occurs.⁷⁰ At that point, it becomes important to continue to push with the same level of intensity.

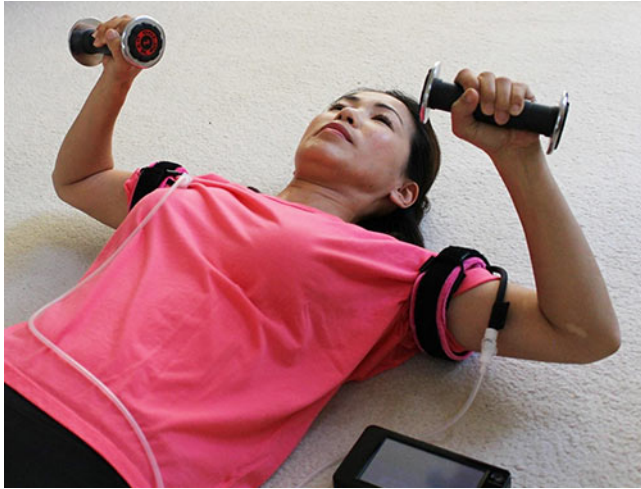
One of the major advantages of KAATSU versus high-load resistance training is that you cause far less muscle damage, which allows you to train more frequently. The frequency of training needs to be individualized as it varies widely. It can range from as little as twice a week up to three times a day, depending on your fitness and training goals.

Typically, the lower the percentage of 1RM used, the more frequently BFR can be done.⁷¹ Heart rate variability and the Oura ring can also be used to determine your ideal recovery periods. The Oura ring measures your heart rate all night and will tell you not only your lowest heart rate but also at what time it occurs. The higher your heart rate and the closer your lowest heart rate time is to awakening, the more recovery you need.

How to Perform BFR

Begin by applying the bands to your upper arm, very close to your armpit, just where your bicep muscle begins and deltoid muscle ends.

On your legs, you can apply them right below your hips at the top of your quads, close to your groin. There are misconceptions that you need to put the bands close to the muscle



you are seeking to focus on, but this is unnecessary.

There is a crossover training effect and your muscles that aren't blood flow-restricted will also receive benefit once the bands deflate. In other words, you will gain benefits in your chest muscles even though you are only restricting your arm muscles.

Do not put the bands over your knees or elbows, as this could cause nerve damage. Only put the bands on your body as described above, because the goal is to increase your vascular elasticity and elicit a metabolic and hormonal response that ultimately leads to aesthetic and muscular improvement.

When you engage in the exercise properly, lactic acid will accumulate in the muscle, which will be associated with a burning-like pain due to the excess hydrogen ions being produced. It will clearly be uncomfortable, especially as you push to muscle fatigue. It is important to understand that this subjective sensation of discomfort will improve with time.

It will likely take four to six weeks to develop the strength and hypertrophy gains. Once achieved, a study⁷² in elderly participants showed that doing BFR training twice a week was sufficient to maintain the gains. When training decreased to once a week, the gains failed to be maintained.

If you are able to, there is benefit to doing BFR every day. You can just vary the number of exercises you do per day. It could be as simple as applying the bands to your legs and walking for 30 minutes, or putting them on your arms and swimming. It doesn't have to involve weights. You can also use them in your favorite sport.

Get Stronger and Healthier With Age

In summary, the four key lifestyle strategies that have allowed me to get healthier with age are TRE in combination with a cyclical ketogenic diet (which I'll review below); exercising while fasting; and using KAATSU in my strength training routine.

While doing any one of these in isolation would likely improve your health, when done in combination, they really catalyze synergistic changes that optimize your entire system. The best news of all is that it's never too late to start. My transformation began in my 50s, and I feel better now at 69 than I did back then. You can transform your health and physique too. You just have to get started, and keep going!

Your Food Choices Are Crucial for Muscle Building

My understanding of optimizing nutrition for health has been a greater than five-decade journey. At the beginning, I fell into the low-fat diet myth and thought I was eating healthy with my grains and margarine alternatives, but I was fooled. The key here is that I was motivated to make the right choices: I simply lacked proper mentoring and information.

That was one of the primary reasons I started this website over 25 years ago. I believed that people didn't need to make the same silly mistakes I made, and by sharing my insight I could save them needless pain and grief.

Another major mistake I made was never taking time off from eating. It seemed to make sense that you need to eat around the clock, and that going without food for days could wreck your health by losing muscle mass from inadequate protein intake. After researching this, I realized it was seriously wrong and counterproductive. Your body actually requires regular intervals when you aren't eating, and failing to do so is a prescription for metabolic disaster.

Research by Satchidananda Panda, Ph.D., suggests 90% of people eat across more than 12 hours per day, and perhaps 50% of the population eat across 16 hours a day. There are even many who wake up in the middle of the night to eat.

This constant hunger occurs because when you're using carbs rather than fat as your primary fuel, you need constant refueling as carbs burn so much quicker than fat. I wrote extensively about this in my best-selling book, "[Fat for Fuel](#)," Since your body has a minute supply of stored carbs relative to fats, you need to eat far more frequently to avoid feeling ravenously hungry and tired as your body runs out of fuel.

The remedy for this is twofold: Eat a cyclical ketogenic diet (high in healthy fats and low in carbs, with higher amounts of carbs cycled in), and restrict the window of time in which you consume all your meals each day. Both of these strategies will help retrain your body to burn fat for fuel, which is a sign of metabolic flexibility that is crucial for optimal health, and once you can burn fat, hunger is significantly decreased and you can go without food far longer.

Time-Restricted Eating Is a Key Health Principle

Time-restricted eating (TRE) is one of the most important health principles of our time. Contrary to modern belief, your body isn't designed to be fed throughout the day, and the near-continuous grazing that most engage in can have serious health consequences.

When you eat throughout the day and never skip a meal, your body adapts to burning sugar as its primary fuel, resulting in the downregulation of enzymes that utilize and burn stored fat.^{73,74} As a result, you become progressively more insulin resistant and start gaining weight. Many biological repair and rejuvenation processes also take place while you're fasting, and this is another reason why all-day grazing triggers diseases while fasting prevents them.⁷⁵

Even though TRE was a major breakthrough for me, I have recently come to realize that it is not for everyone. However, it is for most people as [95% of the people in the U.S. are metabolically inflexible](#). If you are insulin resistant than TRE is vital to implement but only until you become insulin sensitive.

If you continue TRE for too long, you will create inflammatory stressors by having your body generate cortisol to have your liver create glucose because your body is low in it.

So once you become metabolically flexible it is important to increase your eating window to eight to 10 hours or even 12 hours in the summer.

There are a number of different intermittent fasting regimes, some of which are more extreme than others, but all are based on the premise that you need to fast for periods of time. TRE is one of the easiest to follow as you simply abstain from food for 16 to 18 hours a day and eat all your meals within a window of six to eight hours. A six- to eight-hour window seems to be close to the metabolic ideal for most.

You Must Eat Adequate Protein to Increase Muscle Mass

Your muscle is made of protein and if you don't supply enough of the raw material your body will not be able to generate new muscle tissue. Fortunately, there is an easy formula to follow that will supply the crucial amino acids your body needs to stimulate muscle protein synthesis.

The most important amino acids will be the branched chain amino acids, leucine being the key. You will need about three grams of leucine within one to two hours of your workout to activate mTOR, the anabolic signal and trigger to build tissue.

If you eat enough high-quality protein according to the following formula you will invariably have enough leucine. The minimum is about 1.2 grams of protein per kilogram of body weight (0.54 grams/pound) per day. Athletes and the elderly could benefit from even higher levels at 1.6 grams/kilogram (0.71 grams/pound).

Just be sure to avoid seeds and all nuts (except macadamia) as they are high in omega-6 fat linoleic acid (LA), which will cause other metabolic complications. Chicken and pork should also be avoided as they are monogastric animals that are fed commercial grains that are high in LA. They also have high LA levels in their tissues.

Sources and References

-
- ¹ von Haehling S, Morley JE, Anker SD. From muscle wasting to sarcopenia and myopenia: update 2012. *J Cachexia Sarcopenia Muscle* 2012;3:213–217

- ² I.H. Rosenberg Sarcopenia: origins and clinical relevance *J. Nutr.*, 127 (5 Suppl) (1997), pp. 990S-991S
- ³ Aversa Z, et al The clinical impact and biological mechanisms of skeletal muscle aging. *Bone*. 2019 May 22;127:26-36. doi: 10.1016/j.bone.2019.05.021
- ⁴ *Calcif Tissue Int.* 2018; 103(1): 35–43. doi: 10.1007/s00223-018-0388-2
- ⁵ *J. Gerontol. A Biol. Sci. Med. Sci.*, 64 (12) (2009), pp. 1333-1336. doi: 10.1093/gerona/glp130
- ⁶ *J. Am. Geriatr. Soc.*, 51 (3) (2003), pp. 314-322
- ⁷ *J. Gerontol. A Biol. Sci. Med. Sci.*, 71 (1) (2016), pp. 63-71
- ⁸ *Fed Pract* 2017 Jul 9;34(7):24-32
- ⁹ *Cell Metab* 2009 Dec;10(6):507-515
- ¹⁰ *Cell Metab*10:507–515
- ¹¹ *Cell Biol.* 2005 Oct;37(10):2047-63
- ¹² *Diabetes* 1982 Nov; 31(11): 957-963
- ¹³ *N Engl J Med* 1990; 322:223-228
- ¹⁴ *Diabetes Care* 2009 Nov; 32(suppl 2): S157-S163
- ¹⁵ *Int. J. Biochem. Cell Biol.* 2005, 37, 2047–2063
- ¹⁶ *J. Gerontol. A Biol. Sci. Med. Sci.* August 2018; 73(8): 1070-1077
- ^{17, 27} *Redox Biol.* August 2020; 35:101513
- ¹⁸ *Surg Today.* 2018; 48: 151–157
- ¹⁹ *Ageing Research Reviews* 2018 Nov;47:123-132
- ²⁰ *Liver Transpl.* 2013 Dec; 19(12): 10.1002/lt.23752
- ²¹ *Clin. Cancer Res.* 2009 Apr 15;15(8):2920-2926
- ²² *Cancer* 2014 Sep 15;120(18):2910-2918
- ²³ *Arch Gerontol Geriatr.* May-Jun 2019;82:100-105
- ²⁴ *J Am Geriatr Soc.* 2017; 65: e18–e22
- ²⁵ *Autoimmun Rev.* 2018; 17: 518–529
- ²⁶ *EBioMedicine.* 2019 Nov;49:381-388
- ²⁸ *Age Ageing.* 2019; 48: 16–31
- ²⁹ *Ageing Research Reviews* 2019 Dec;56:100960
- ³⁰ *J Physiol* 2015;593:2721–2734, doi:10.1113/JP270343
- ³¹ Toda N. Age-related changes in endothelial function and blood flow regulation. *Pharmacol Ther* 2012;133:159–176, doi:10.1016/j.pharmthera.2011.10.004
- ³² *Life Sciences* Volume 118, Issue 2, 24 November 2014, Pages 97-109 doi: 10.1016/j.lfs.2014.09.009
- ³³ *J Cachexia Sarcopenia Muscle* 2016; doi:10.1002/jcsm12105
- ³⁴ *Am J Physiol Cell Physiol* 2013;304:C717–28
- ^{35, 65} *Frontiers in Physiology* 2019; 10: 533
- ³⁶ *Sports Med.* 45, 313–325. doi: 10.1007/s40279-014-0288-1
- ³⁷ *Eur J Appl Physiol Occup Physiol.* 1998;77:189–191
- ³⁸ *Front Physiol.* 2019; 10: 446, Discussion: Muscle Strength
- ³⁹ *J Appl Physiol.* 1996;81(5):2004–12
- ⁴⁰ *Microvasc Res.* 1968;1:1-14
- ⁴¹ *J. Strength Cond. Res.* 26 611–617. 10.1519/JSC.0b013e3182281c69

- ⁴² Robergs, RA, et al. Biochemistry of exercise-induced metabolic acidosis. *Am J Physiol Regul Integr Comp Physiol* 287: R502–R516, 2004
- ⁴³ *Clin Physiol Funct Imaging*. 2015 May;35(3):197-202. doi: 10.1111/cpf.1214
- ⁴⁴ *FASEB J.* (2012) 26:3691–702. 10.1096/fj.11-203026
- ⁴⁵ Ekmekcioglu C Nutrition and longevity - From mechanisms to uncertainties. *Crit Rev Food Sci Nutr*. 2019 Oct 21:1-20. doi: 10.1080/10408398.2019.1676698
- ⁴⁶ Musaro, A, et al Counteracting sarcopenia: the role of IGF-1 isoforms *Aging (Albany NY)*. 2019 Jun 15; 11(11): 3410–3411. doi: 10.18632/aging.102027
- ⁴⁷ *J Hum Kinet*. 2018 Dec; 65: 249–26
- ⁴⁸ *Cell* 2019 Mar 7;176(6):1248-1264
- ⁴⁹ *Med Sci Sports Exerc*. 2012 Nov; 44(11): 2077–2083
- ⁵⁰ *J Physiol* 2012; 590(17): 4351–4361, Myogenic stem cell content Page 4355 (PDF)
- ⁵¹ *Journal of Applied Physiology* May 1, 1999; 86(5): 1513–1518
- ⁵² *Mol BiolCell*. 2000;11(5):1859–97
- ⁵³ *J Appl Physiol*.2012;113(2):199–205
- ⁵⁴ Schoenfeld BJ. Potential mechanisms for a role of metabolic stress in hypertrophic adaptations to resistance training. *SportsMed*. 2013;43(3):179–94
- ⁵⁵ *J Appl Physiol*. 2010;108(6):1563–7
- ⁵⁶ *Med Hypotheses*. 2012;78(1):151–4
- ⁵⁷ *J. Appl. Physiol*. 2015;118:742–749. doi: 10.1152/jappphysiol.00054.2014
- ⁵⁸ *Nutrients*. 2019 Apr; 11(4): 869. doi: 10.3390/nu11040869
- ⁵⁹ Lang F, Busch GL, Ritter M, et al. Functional significance of cell volume regulatory mechanisms. *Physiol Rev*. 1998;78(1):247–306
- ⁶⁰ *Ther. Adv. Psychopharmacol*. 2017;7:85–89. doi: 10.1177/2045125316675579
- ⁶¹ Brooks G.A. The Science and Translation of Lactate Shuttle Theory. *Cell Metab*. 2018;27:757–785. doi: 10.1016/j.cmet.2018.03.008
- ⁶² *Neurosci. Lett*. 2011;488:234–237
- ⁶³ *Med. Hypotheses*. 2017;106:1–5
- ⁶⁴ *Neurosci. Lett*. 2016 Sep 6;630:247-253
- ⁶⁶ *Sports Medicine* 2013;43:179–194
- ⁶⁷ *Frontiers in Physiology* June 2019 (PDF)
- ⁶⁸ *JAMA Network Open* September 25, 2019
- ⁶⁹ *Medical Hypotheses* February 2015;84:145–149
- ⁷⁰ *J Sports Sci*. 2019 Aug;37(16):1857-1864
- ⁷¹ *Frontiers in Physiology* 2019; 10: 533, BFR-RE
- ⁷² *Proceedings of the International Conference on Sports and Exercise Science 2009*. Bangkok, Thailand Pages 336-341 (PDF)
- ⁷³ *Cell* February 8, 2018; 172(4): 731-743.E12
- ⁷⁴ *Medical News Today* February 8, 2018
- ⁷⁵ *Science* November 16, 2018; 362(6416): 770-775, Page 1