The Ultimate Warm-Up with

Vasomotion

by Willard Sheppy

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The Ultimate Warm-Up

A look into microcirculation and vasomotion

It's no secret that— with our sedentary 9-5's, mainstream malnutrition, and glorified "no-sleep" lifestyle—our health as a collective in the U.S. has never been worse.

Most people focus on muscle mass or body fat as indicators of a healthy body.
Yet some of the most influential factors to our health are relatively minor in size.

Microcirculation is a powerful indicator of health. When it is functioning well, our bodies have access to all supplies they need and they can easily get rid of the waste products it doesn't. When microcirculation becomes impaired through lifestyle or disease, we can find ourselves feeling awful without really understanding why.

One of the best ways of improving microcirculation is by improving vasomotion. Vasomotion is the opening and closing of the capillary beds. Vasomotion is the traffic lights of our circulatory roadways. It responds and adjusts perfectly to, not only the local coming and going of blood flow traffic, but to the system-wide flow.

In this guide, I will explain in great detail about microcirculation and vasomotion. I will start by using metaphors to make the concept of microcirculation easy to grasp; these concepts form the foundation of the Ultimate Workout. I then go into the medical science behind this metaphor.

This may be more detail than you're looking for, but I want to provide the scientific understanding behind these exercises for interested readers. I bold and underline important concepts for those readers that would like to skim through this book. I then use the medical concepts described to individually explore the
benefit of each exercise used in the Ultimate Workout. Lastly I provide an easy to use chart, highlighting the benefits of each exercise.

Introduction

Cars and City Analogy

Think of our body's circulatory system like a road network. Our large arteries and veins are highways. Our capillary beds are city streets complete with sidewalks, bike lanes, and the towns and market places built on these city streets. Our blood cells are cars that move along the roads.

The road network's primary purpose is to move goods to towns and markets to exchange products and make life happen. While highways are big, the significant interactions happen in the cities and markets, our capillary beds.

And although our arteries and veins are essential for transportation, the energy that drives our bodies are walking along the sidewalks of our capillaries through cellular exchange.

You can't just stop on the side of a major highway to deliver a package. So, even though the major blood vessels get blood to where it needs to go quickly on the highway, the smaller capillary beds are essential for the picking up and dropping off of packages. Capillary beds allow your cells to transport different supplies directly to their destination. If capillary beds or small city streets didn't exist, we would just be throwing products out the window, hoping that they arrived at their final destination.

And each car, or blood cell, needs oxygen and fuel and must get rid of the waste combustion. Our cells are similar. We need oxygen combined with glucose to produce energy, and we need to get rid of CO_2 and waste by exhaling and excreting.

If one of the systems breaks down—if one of those cars breaks down—the whole system slows down, traffic gets jammed, combustion will falter, we will run out of fuel, and waste builds up in our bodies.

But instead, by optimizing this road network (much like when a civil works project straightens a road or installs a multi-lane bridge), we'll have more power from our engines, our cars become more fuel-efficient, and we can have a smooth flow of traffic for an optimal body system.

The Cardiovascular Problem

When we look at the US as a whole, one of the leading causes of sub-optimal health in America is cardiovascular systems dysfunction.

And when most people hear about cardiovascular problems, they think of heart attacks, strokes, aricose veins, and hypertension. They often think about the larger organs in the body--the heart, lungs, and major arteries.

And although these are important, the more significant issues could be masking more intricate, smaller problems.

To help us understand the issues of the heart and these major organs, we need to look at the more minuscule systems underlying these organs, like microcirculation and capillary beds. We need to take a closer look at our capillary beds, our microcirculation, and most importantly, our vasomotion.

And to later improve on these functions, we should first learn how they work and how they can affect our health in an uncomplicated, easy way. Let's start by first defining these terms.

Chapter 1 Science Stuff

What is Microcirculation?

Microcirculation is the circulation of the blood in the smallest blood vessels.
Microcirculation represents the busiest sidewalk and bike lanes weaving about in our bodies. As the major location for nutrient exchange marketplaces, microcirculation is highly responsible for getting what your body needs to the places it needs to go.

And if you've lived in a city, you'll know--traffic never slows down.
Why? Well, microcirculation is all about flow and exchange. When there is a constant ebb and flow in the system, that system will always be active.

Functions and Responsibilities

Microcirculation plays a vital role in the transportation of:

- Nutrients
- Oxygen
- Hormones
- Waste Products
- Water
- Heat
- Respiratory Gases

--between the blood and body's tissues and organs.

It can also play a role in the release of metabolic products.

And just like any busy street at rush hour, when microcirculation is disrupted in a traffic jam, it stops the nutrients from spreading to neighboring tissues.

A microcirculation traffic jam can make a person feel lethargic and weak without necessarily having anything noticeably wrong with them.

And at the base of this transportation highway is the capillary bed, an interwoven network of capillaries that bring nutrients to an organ and take waste products away.

The capillary bed works with two main pressures. One that pushes things out of the vessel and one that pulls things into the vessels. Hydrostatic pressure from our heart pushes things out of the blood vessels and the osmotic pressure exerted by the proteins in our blood pulling things into the blood vessel . At the arterial end, closer to the heart there is more pressure from the heart so more things go out of the blood vessel, but on the venous end, further from the heart, the pressure from our heart decreases and there is more force pulling things into the blood vessel. Overall, across the entire circulatory system, there is more flow going out of the blood vessel and into the neighboring tissue. This excess is then picked up by the lymphatic vessels, cleaning out the excess and looking for pathogens.

What is Vasomotion?

Seemingly small in size but rather significant in function, Vasomotion or Flowmotion Vasomotion, is an intricate, rhythmical contraction–relaxation mechanism that occurs in our capillary beds.

Vasomotion is the traffic lights of our circulatory roadways. It responds and adjusts perfectly to, not only the local coming and going of traffic, but to the system wide flow. If you have ever watched a heist movie, where a nerdy computer hacker takes over the street lights system, you will have an idea of what vasomotion is doing. By adjusting the stop and go of traffic, the computer hacker controls the flow to help the thefts get away from the police. This is the basic idea of what vasomotion is doing, but rather than one heist taking place, there are many all over the city. Vasomotion helps control the flow of traffic in our body, so that it can operate more smoothly and efficiently.

What does it do?

Vasomotion continuously adapts blood flow to meet the needs of the tissue nearest to it and the body system wide.

This adjustment happens primarily in our arterioles,a small branch of an artery leading into capillaries, where our fluid and nutrient exchange is regulated between our vascular system and tissues.

When we think about arteries and veins, we often imagine them as these passive tubes through which the heart pumps blood. However, arteries are anything but passive.

Actively pumping, constricting, and dilating to help move blood through, our arteries and veins contract and expand through this process called vasomotion. **This pumping mechanism of vasomotion optimizes the flow of blood and the exchange of energy.**

This system is similar to how the lungs pump to move air. Although we have large passageways like the lung's bronchial, there's no oxygen exchange going on in there. Oxygen exchange happens, instead, at the smallest levels of the organ--the alveoli sacs.

Just like our lungs, our large blood vessels can be considered dead space since oxygen exchange happens at the smallest level in our capillary beds (recall the delivery driver who can't just throw a package off the highway).

Vasomotion is controlled by smooth muscle sphincters that dilate to allow blood flowing in and contract to increase blood flowing out. This pumping mechanism uses this cycle of motion to improve exchange efficiency.

When contracted capillary beds improve clearing out of excess fluid (swelling) and cellular debris because of the net flow from tissue is out into the veins. When they are open they allow improved exchange of nutrients and oxygen. If this opening and closing are not tightly regulated, then you can either have too much going out or too much coming into the tissue

Autoregulation

If the vascular system were passive, there would be a linear relationship between blood pressure and blood flow. An increase in pressure would cause a rise in blood flow through an organ.

In fact many organs, including the brain and the kidney, are equipped with vessels that respond to a rise in blood pressure through vasoconstriction. Such vasoconstriction opposes the increase in blood flow that would otherwise cause pressure to go up in a totally passive vascular system.

So, with the opposing pressure, circulation stays stable. Autoregulation is achieved mainly by the arterioles. In the car analogy this means we stop cars from exiting the highways. The body controls flow by closing down off ramps. This protects the capillary network from pressure variations, which would otherwise throw off the vessels' equilibrium.

Vascular self-regulation has two functions:

1) Ensures constant blood flow to an organ, even when there's arterial pressure change.

For example, in the kidneys, the arterial resistance adapts automatically to falling blood pressure. But when systemic arterial pressure rises, kidneys vasoconstriction occurs to maintain constant kidneys blood flux.

2) Adjusts blood flow to the demand and need of organ activity.

For example, in active muscles, the circulation rate can be several times higher than the value of resting blood flow. To respond, blood vessels of the muscles open up to increase blood flow and in areas that are less active like the stomach they will close down to decrease flow.

These adjustments of open and closing happen at different rates and frequencies. The fastest frequency of this is responding to our heart rate, closely followed by breathing respiration, and smooth muscle contractions.

Later in this guide, I want to show you how to affect the vasomotion frequencies in your body. You will learn how each technique affects each frequency and how they work together to balance the body. But first, let's go over these frequencies real quick.

Vasomotion Frequency

Need to know: Hertz means one cycle per second.

Cardiovascular Activity

0.97 Heart 1.66 - 0.625 second to cycle (1 sec).

Around 1 Hz, corresponding to cardiac activity.

The basic frequency near 1 Hz in the ECG signal, which dominates in the blood pressure, **corresponds to the heart rate**. At rest, it varies from 0.6 Hz in Athletes to 1.6 Hz in subjects with impaired cardiovascular systems.

The effect of the heart pumping is manifested in the vessels.

Respiratory Activity

0.27 Lungs 6.89-1.66 seconds to cycle (5 sec).

Around 0.2 Hz, corresponding to respiratory activity.

Modulation in this frequency interval corresponds closely to the respiratory.

The effect of breathing is manifested in the vessels

Smooth Muscle Activity

0.13 Smooth Muscles 6.89 to 18.86 seconds to cycle (15 sec).

Spontaneous activity recorded in microvascular smooth muscle cells was in the range 0.13hz 4–10 cycles per minute

The smooth muscles surrounding the blood vessels contract in response to an increase of intravascular pressure and relax in response to a decrease of pressure. This helps the blood flow to an organ stay constant. This is called myogenic autoregulation. Myogenic is just a fancy term meaning coming from the muscles and autoregulation implies, it is an automatic process which is not controlled by nerves.

Wavelet analysis has shown that myogenic oscillations' amplitude is increased by exercise and decreased by local cooling.

Activity in the Autonomic Nervous System

Autonomic Nervous System 18.86 to 47.61 seconds to cycle (30 sec).

Around 0.03 Hz, corresponding to neurogenic activity.

The autonomic nervous system can impact all the above systems, Heart, Lung Smooth Muscles

The autonomic nervous system innervates the heart, lungs, and blood vessels, except capillaries. The autonomic nervous system maintains the base level of contraction of the vessels. The nerves cause the release of substances that affect smooth muscles' activities, leading to changes in the vessels' radii and resistance.

That means that the nervous system takes part in vasoconstriction. The peak around 0.03 Hz has been observed in blood pressure, blood flow, and heart rate variable signals.

Nitric Oxide Endothelial Activity

Endothelial metabolic 47.61 to 105.26 seconds to cycle (1 min).

Around 0.01 Hz, corresponding to Nitric Oxide-related endothelial activity.

The blood supplies the cells with nutrients and removes their metabolism's waste products while circulating the circuit of vessels. The substances related to metabolisms such as O2, CO2, NO and Lactic acid directly affect the vascular musculature state of contraction. The control of the blood flow based on the concentrations of cellular metabolism is termed metabolic regulation.

It seems **that endothelial cells' activity mediates metabolic regulation of the blood flow through adjustment of the concentrations of various substances. Nitric oxide (NO)** is one of the most essential vasoactive substances.

Prostaglandin Endothelial Activity

Endothelial activity 105-200 seconds to cycle (2 mins).

Around 0.007 Hz, apparently corresponding to Nitric Oxide-independent (probably prostaglandin-dependent) endothelial activity.

This frequency was not identified in some of the earlier studies because the 20-minute recordings provided insufficient low-frequency resolution, and these oscillations were filtered out during data pre-processing.

However, a strong peak was later observed around 0.007 Hz] and is clearly evident in the present work. It was found that this frequency differs between healthy subjects and heart failure patients.

How Does Vasomotion Affect Us?

Knowing about vasomotion can be great for a medical student, someone learning or working in the health field, and someone looking to understand more about how their body works.

Let's take a closer and more realistic look at how vasomotion can affect our health in a day-to-day way:

When there are changes in the frequency of opening and closing of our capillary beds, these characteristics can lead to certain diseases. These indications were so strong that in severe cases, vasomotion improvement was actually considered a better indication of survival rate than the typical vital signs of heart rate, blood pressure, etc.

And on the flip side, a decrease in vasomotion increases the likelihood of death.

Disease Changes in Vasomotion

Vasomotion can actually change because of certain common diseases. For example, obesity and diabetes change vasomotion:

Obesity

The importance of a metabolic component has been supported by reducing all types of vasomotion in obese patients, regardless of diabetes status. The demonstration that sustained weight loss can fully normalize vasomotion in the skin.

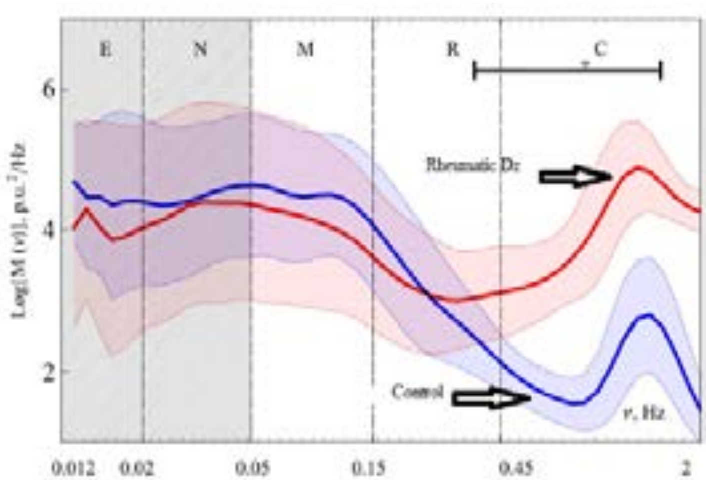
Fibromyalgia

Apart from widespread pain, which is the main symptom of fibromyalgia, a great variety of functional changes occur in this disease's presence.

Such changes include alterations in microcirculation, which may cause pain. There is a reduction in regional blood flow above "tender points" in fibromyalgia patients compared with healthy controls. Microcirculatory improved over the tender points in fibromyalgia patients after acupuncture therapy. This data suggests that acupuncture is a useful method to treat fibromyalgia patients as it can alleviate pain.

Diabetes

There is substantial evidence that diabetes both in humans and in experimental animal models is associated with an altered pattern and/or reduced prevalence of vasomotion.



Zharkikh, Elena V., et al. "Blood flow oscillations as a signature of microvascular abnormalities." Biophotonics: Photonic Solutions for Better Health Care VI. Vol. 10685. International Society for Optics and Photonics, 2018.

Averaged spectra of LDF records. Blue areas correspond to the control groups, red patients (patients with rheumatic diseases. The thick color line in the middle of the region corresponds to the average value, the thin lines along the edges of the region are standard deviations from the sample. Thick black lines in the upper parts of the plot indicate the frequency band, where M( ) is significantly different ($p < 0:05$)

For diabetes the reduction of vasomotion is from a decrease in the autonomic nervous system frequency. The sympathetic innervation alteres vasomotion in diabetes is due in part to the associated neuropathy..Vasomotion affected by diabetes has a frequency of 0.012-0.045 Hz,), which is the frequency range associated with influence from the sympathetic nervous system and because the abnormality is predominantly seen in diabetic patients with neuropathy.

The effect of insulin on the endothelium is significant for the enhancement of capillary perfusion and glucose uptake in skeletal muscles. It has even been suggested that the impaired vasomotion in type 2 diabetes may favor the development of high blood pressure.

Rheumatoid Disease

Patients with Rheumatoid Disease had significantly higher-averaged blood saturation in base conditions in comparison to health people. Higher amplitudes of oscillations in the frequency range above 0.1 Hz (Cardiac Activity) were observed for patients with rheumatoid disease. This can be explained by the structural and functional changes in microcirculation occurring in the development of rheumatoid disease.

Septic

Septic shock is characterized by profound hemodynamic alterations associated with organ dysfunction.

These hemodynamic alterations include some degree of hypovolemia (a decreased volume of circulating blood in the body) and a decrease in vascular tone, and myocardial depression. Even when systemic hemodynamic variables seem to have been corrected and are within therapeutic goals, signs of impaired tissue perfusion may persist.

Recently, alterations in microcirculatory blood flow have been identified in severe sepsis, and the severity of these alterations is associated with a poor outcome.

Microcirculation is so important even when all other vitals are normal. Alteration in microcirculation is a great indicator of mortality in septic patients.

You can have one capillary bed open right next to one that's closed. This would mean that some tissues would be getting oxygen right next to tissues that are without oxygen.

This decreased capillary density results in an increased diffusion distance for oxygen.

If microvascular blood flow is not congruent. You can have perfused capillaries in close vicinity to non-perfused capillaries. This leads to alterations in oxygen extraction and hypoxic zones even when total blood flow to the organ is preserved.

Heterogeneity or inconsistency in microvascular perfusion is a crucial aspect. Heterogeneous perfusion leads to more severe alterations in tissue oxygenation than homogeneously decreased perfusion does. Heterogeneity of perfusion is associated with heterogeneity in oxygenation but also has altered oxygen extraction capabilities. During episodes of hypoperfusion, the heterogeneity of microvascular perfusion further increases in sepsis instead of being minimized as in normal conditions.

These alterations play an important role in the development of organ dysfunction. They're not just an indication of the severity of sepsis.

Microvascular alterations can lead to cellular injury, and reversal of these alterations is often associated with improvement in lactate and mitochondrial function, suggesting that microvascular alterations directly impair tissue oxygenation.

In addition, several trials have demonstrated an association between the severity of microvascular dysfunction and the development of organ dysfunction and mortality.

What can we do to improve our microcirculation?

We need to do activities that regulate and improve or vasomotion frequencies. We need to bring into balance our Autonomic Nervous System which regulates our Heart and Lungs. We need to use gentle exercise and hydrotherapy to improve our smooth muscle frequency. Breathing and movement techniques that can balance nitric oxide and other vasodilating gasses in our body.

Next we will start looking into movement and exercises to improve vasomotion. There is not a direct one to one correlation but there are preferences toward certain exercises and frequencies. For example changing our breathing will affect our respiratory vasomotion frequency, but it will also impact our autonomic nervous system frequency. We also know that hydrotherapy has an impact on our smooth muscle frequency. Below is a chart where I have provided preferences towards certain frequencies. Boxes that have three squares have a larger impact on that frequency than those with one.

	HT	Lung	SmoMuscle	ANS	NO	ProsG
Exercise						
Shaking			■■	■	■■■	
Patting			■	■■		■■■
Stretching			■■■	■		■■
Breathing						
Nose		■■■	■	■■		
Mouth		■■■	■	■■		
Diaphragm	■	■■■		■■		
Chest	■	■■■		■■		
Humming		■■		■	■■■	
Holding		■■■	■■	■		
Hyperventilating	■	■■■		■■		
Hydrotherapy						
Cold Body			■■■	■■		■
Cold Face	■		■■■	■■		
Hot Body	■■■		■	■■		
Hot Feet	■■■		■	■■		

Chapter 2

Movement Stuff

When we exercise to improve microcirculation, we need to be careful not to overdo the sympathetic nervous system's stimulation. If we exercise too hard, too fast, we will begin to close off circulation to specific areas in our body.

Exercise Recovery: Sympathetic vs. Parasympathetic Involvement

The human body is intelligently balanced with a complex, built-in network for adapting to stress. This network is known as the autonomic nervous system. It is then divided into two unique subsystems: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS).

The parasympathetic and sympathetic nervous systems both deal with metabolism, which is a biochemical process within the body that allows healing, growth, and adaptation. Metabolism builds up and breaks down resources within the body and are divided into catabolic and anabolic processes.

Sympathetic Nervous System

The sympathetic nervous system (SNS) is catabolic, meaning it breaks down resources, usually creating energy that is easily accessible. It mobilizes these vital resources to help the body defend itself when it's in danger. The SNS is responsible for turning on that "fight or flight" mode in threatening situations.

This system is more sensitive during workouts.

In addition to the physical stress they can experience regularly, emotional/mental stress can also play a role in becoming SNS-dominant.

The following can put an additional burden on someone's nervous system:

- Stress at home or at work.
- An upcoming event or season that requires increased training intensity and/or frequency.
- Nervousness or anxiety about an upcoming event or season.
- Acute or chronic psychological disturbances including depression or anxiety.
- Physical illness, either transient or chronic.
- Restricted caloric intake

In addition to the regular physical stress your body undergoes as part of living life, stressors like those above can tip the balance towards your SNS and strain the body's natural process of maintaining homeostasis.

This is especially true if treatment methods, like the Ultimate Warm Up are not used to minimize sympathetic dominance and boost parasympathetic activity.

Parasympathetic Nervous System

The parasympathetic nervous system (PNS) is anabolic, meaning it builds up resources within the body, requiring energy to perform, adapt, and recover. It also helps the body to rest, digest, and recover after workouts and strenuous activity. A well-balanced nervous system spends most of its time on parasympathetic activities. An active PNS helps muscle soreness and swelling subside more quickly.

Those who are chronically ill are vulnerable to becoming SNS-dominant because they experience increased physical stress regularly.

By spending more time on sympathetic activities–and less time on parasympathetic activities, their nervous system has a more challenging time helping their bodies recover.

The Exercise Paradox

From athletes who are functioning at their peak health to people who are coping with chronic illnesses, physical activity has always been a cornerstone of a healthy lifestyle.

However, when comparing these two very different extremes of lifestyle, there are very critical points that most people miss.

It starts with accepting this fact: moderate and intense exercise affects a healthy body and a sick body in very different ways.

It would help if you also recognized that:

1. Too much exercise stimulates the sympathetic nervous system (fight of flight), and can harm circulation.

2. Recovery is equally or even more important than the actual workout itself. There needs to be a balance in recovery—between exercises and after training—and the workout itself.

In this next section, we will go over how a workout can look very different from one person to another.

How Exercise Works For An Athlete

For an athlete, or for the averagely fit person, moderate to high-intensity workouts push the body up to and beyond its limits.

During the workout, muscle tissue breaks down, and your system enters a state of stress.

After breaking your body down, your healthy immune and nervous systems then kick into repair mode. This is when you begin to recover and build muscle.

Once you fully recover, you'll be stronger, faster, and/or more flexible than you were before. After that brief break, you can then start the cycle over again, increasing your performance ability each time.

How Exercise Works in Chronic Illness

Exercise for a chronically ill person doesn't work the same as it would for the person above. Learning how the body processes stress can help us understand why.

Externally, stress comes in different forms; physical, mental, or emotional. We can experience stress that lasts only moments or stress that lasts years.

But internally, our nervous system handles all of those stress types in the same way.

This fact makes it difficult for someone with a chronic illness to train hard: Stress from chronic inflammation and from a 10-mile run looks the same to our nervous system.

For example, rheumatoid arthritis, type 2 diabetes, and fibromyalgia seem to have dysfunctions in the autonomic nervous system. This leads to an increase in their sympathetic nervous system activity.

This higher sympathetic tone never allows the body to enter into the recovery phase fully. So, the chronically ill person can't heal from intense exercise fully. This makes moderate to high-intensity exercise dangerous to someone who is chronically ill.

Phases of Exercise

Learning the primary phases of exercise can be helpful when looking at it in a more in-depth way.

The First Phase: Metabolic Changes

When you're training, your body first goes through metabolic changes. Your muscles begin to use up oxygen through glycolysis (the processing of food into energy), which will then signal the release of adenosine and nitric oxide.

The peripheral blood vessels (surrounding your muscles) will then dilate, sending a signal to dilate upstream vessels. As the body works it will also release CO_2 which increases acidity of the blood making it easier for hemoglobin to release oxygen back into the muscles.

The Second Phase: Nervous System Changes

After metabolic changes, your body will then go through autonomic changes. The peripheral dilation of blood vessels in the muscles causes a slight drop in blood pressure, stimulating the sympathetic nervous system to kick in.

This sympathetic nervous system causes an overall increase in blood vessel contraction, balancing out the drop in phase one. It does this by redistributing where the blood is in the body. It moves it away from organs that it considers not important at the moment to support our muscles.

Our muscles use so much blood (especially during a workout) that if we didn't have this redistribution of blood, our muscles would pull so much from our other organs, we would pass out.There has to be balance in blood vessel constriction and dilation. If our body was a water balloon if you squeeze one side the other side will bulge. If you try to squeeze or pull on both sides at once the balloon will pop.

The redistribution of blood creates an increase in blood flow to certain parts of the skin and muscles.

Moderate exercise will then slightly increase blood to the digestive system and kidneys. However, intense exercise decreases the blood flow to the digestive system, kidney, and bladder.

This is a good example why people with higher levels of anxiety tend to also have cold hands and feet and poor digestion. The elevated sympathetic nervous system moving blood out of those areas.

The Third Phase: Hormonal Changes

At the third and final stage of exercising, your body will begin to experience hormonal changes. These changes are slower acting and occur much later after exercise begins.

When we exercise to improve microcirculation, we need to be careful not to overdo the sympathetic nervous system's stimulation. If we exercise too hard, too fast, we will begin to close off circulation to specific areas in our body.

That is why recovery is a critical step both between exercises and after a workout. Using deep, slow exhalations, you can encourage your body to return to a state of parasympathetic stimulation. Nasal breathing retains vasodilation for gasses like co2 and NO, this helps balance out an overactive sympathetic nervous system vasoconstriction effects.

The Final Phase: Recovery A Window of Opportunity

While stressors like physical exertion can create an unhealthy state of sympathetic dominance, recovery and rest can be that window of opportunity the body needs to maximize benefits.

During this window, many of the processes that bring your body benefits remain highly active. And when combined with the diet rest and ultimate warm up, you can maximize that time, improving the body's adaptation to training. Occurring anywhere from two to three hours after exercise (e.g., post-exercise hypotension), these responses can last up to 48 hours or more (e.g., altered blood lipids).

Research shows that a period of intense exercise increases insulin sensitivity, decreases blood lipid levels, and reduces blood pressure. This state makes the recovery period an ideal time for therapeutic acupuncture intervention.

During this period, athletes take advantage of this recovery period to improve training and athletic performance. This is done so by strategically consuming nutrients rich food at the appropriate time. Optimizing the intake of food, using exercise recovery is a large area of research related to human performance that may also translate to clinical populations and older adults

By using the Ultimate warm up techniques and focusing on making sure we have enough rest, recovery, and fluid intake, we can make sure that our body transitions into the PNS recovery mode and boosts healing.

What does this look like in the real world? Kung Fu masters in their 70's 80's and 90's can go from doing intense, dynamic Kung Fu forms to meditating or taking naps. In this way they bring balance back to their bodies

Chapter 3 Ultimate Warm Up Stuff

The Ultimate Warm Up: Relieving Stress

Our body treats all stress the same, emotion, physical, environment all have impacts on the body. Although not always in our control, being out of balance with too much stress is one of the most damaging things you can do to your body.

Your body goes completely out of whack when you are stressed—bringing you in that "fight or flight" SNS mode that we talked about earlier.

Stress can cause problems with your circulation as well. Chronic stress can contribute to long-term problems for heart and blood vessels.

Have you noticed that you tend to get cold hands and feet when you have anxiety or get stressed? When you are stressed your adrenal glands release a hormone adrenaline. This hormone triggers a chain of reactions that causes the blood vessels in the hands and fingers to constrict, This saves oxygen for vital organs like the heart, lungs and brain, in case you need to escape from a wooly mammoth.

Stress and adrenaline improves macrocirculation at the expense of microcirculation.

Short term this is ok but long term this increase in blood pressure and decrease in microcirculation increase the risk of heart attacks and strokes.

The consistent and ongoing increase in heart rate, the elevated levels of stress hormones, and the boost in blood pressure can all take a toll on the body. When suffered long-term, you increase your risk for developing hypertension, heart attack, or stroke.

Repeated acute stress and persistent chronic stress may also increase inflammation in the circulatory system. That inflammation can happen in the coronary arteries, which is why stress is often tied to heart attacks.

However, by finding ways to reduce your stress, you can save your body from several issues, including circulation. Some great ways to fight stress are with gentle movement like shaking, patting, stretching, and breathing exercises.

The Ultimate Warm Up: Shaking / Vibration

The best example of a vibration-type exercise is the shaking and patting you see top athletes do before a race or competition.

Before the whistle blows, athletes will shake their limbs out or pat down a muscle group or part of their bodies. This is for two reasons. First holding tension in muscles is almost a reflex reaction to stress and the excitement of a sporting event, but overly tight muscles decrease movement efficiency. Athletes shake to release excess muscle tension. Secondly. shaking increases blood circulation engages the muscle in much the same way as more strenuous exercise.

The vibration creates one of the mechanical forces, called shear stress. Shear stress is just the frictional forces the blood exerts as it passes along the vessel. An example of this type of shear stress can be found when blood flows in the vessels during moderate exercise. As shear stress increases the vessel wall increases the production of Nitric Oxide. NO has a strong ability to dilate blood vessels and improve blood flow.

What does this mean for you? Vibration is similar to exercise in improving blood flow. It also can help release muscle tension.

Before you exercise you need to increase blood flow to your muscles, this increase in blood flow warms you up. You literally need to warm up before you workout. An elevated sympathetic nervous system from disease or stress will decrease blood flow and tighten up your muscles. This is the opposite of what we want. We want relaxed muscles with good blood flow. Shaking is the easiest and base way to do both. It can also help improve bone density

When you exercise, you put stress on your bones, muscles, and ligaments. Stress can come from a repetitive impact (like running and jumping) or repetitive flexion and extension (as in weight-lifting).

For many individuals with chronic illnesses that affect the bones (e.g. arthritis) or connective tissue (e.g. inflammatory and autoimmune diseases), this repetitive strain causes more harm than good.

However, your body needs some stress on its bones and tissues to maintain and build density. Density maintenance is especially important for those who have arthritis or early signs of osteoporosis.

The Ultimate Warm Up: Massage, Patting, and Dry Brushing

Not only can a massage bring you great relaxation and relief from the stresses of your life, but it can also stimulate your body's blood flow. Massages can speed up your circulation, moving blood through congested areas.

Additionally, once the pressure applied during your massage is released, new blood can flow in where it once may not have been able to.

During a massage, the motions applied by a therapist aids in flushing lactic acid from your muscles and providing better circulation of your body's lymph fluid.

What does this look like?

A massage can cause a slight redness on the surface of your skin. This is due to the release of histamine, which dilates blood vessels under the skin and gives you that red color. Histamine produces both vasoconstriction and vasodilation. Histamines produce arteriole vasorelaxation increase blood flow into and area. It also causes venular vasoconstriction which is a decrease in blood out of an area. On a large scale this is an inflammatory response and can be bad, but on a smaller scale this response can improve blood circulation

Touching the body also can increase the body's proprioception (awareness of itself in space). This can help you relax an area of tension that chronic stress may cause.

The Ultimate Warm UP: Stretching

Stretching is something that we all do. You'll see dogs do it when they get out of bed. They'll stretch, then yawn. You'll see babies do it. It's a natural process of being a human and animal.

Yet,in our office-working world, most people spend their days sitting at a desk in the same position. Rarely do they take the time to yawn, stretch and move around.This lack of movement can exasperate various physical problems. It decreases circulation and can create microenvironments of waste build up and tension.

Many people make the incorrect assumption that stretching is only helpful for tight muscles. When muscles are tight, you stretch them, and by doing so they get longer.This is incorrect, our muscles don't really stretch. What we're doing is neurologically retraining our muscles so that these movements are considered safe.

If you feel that you are not flexible, it is not because your muscles are tight. It is because your brain is not allowing your muscles to move along to their full length. Your nervous system is inhibiting your muscles from changing their shape as a safety precaution. Sometimes this is for good reason, like protecting an injury but oftentimes is not.

We need to change the way we think about stretching from a mechanical perspective toward the inclusion of the self-regulatory dynamics of the nervous system.

Our connective tissue is densely innervated by proprioceptors/ mechanoreceptors which are responsive to manual pressure and stretching. Stretching of these sensory receptors has been shown to lead to a lowering of sympathetic tone or decreasing stress response. Another way to put it is chronic stress can make us tense. Slow gentle stretching can help balance our autonomic nervous system and make us less tense. .

Stretching benefits goes beyond just muscles and nervous system retraining and into our circulation. Stretching can increase blood flow to your body's tissues and organs and decrease inflammation.

Areas of tension or inflammation can create microenvironments of poor blood circulation and build up of waste products.Stretching is a gentle, non-pharmacological intervention that is an important component of treatment, prevention and of improving poor microcirculation.

When you stretch it stimulates anti-inflammatory agents in the body. So stretching can decrease inflammation. One of the benefits, when we think about yoga and tai chi as being helpful with arthritis and other inflammation, is that we are stretching connective tissue to release anti-inflammatory agents. .

By engaging in full body movement, contracting and relaxing your muscles, you are creating a pumping effect that encourages active circulation.

Contracting your muscles increases pressure in your chest cavity—you squeeze blood out and relax to allow it to flow back in.

How does breathing help?

As you breathe in, the diaphragm pushes down on the internal organs and their associated blood vessels, squeezing the blood out of them. As you breathe out, the abdomen, organs, muscles, and blood vessels flood with new blood.

The rhythmic pumping action, called the respiratory pump, helps not only improve blood circulation, but it also removes waste products from the muscles.

The respiratory pump is also important during stretching because increased blood flow to the stretched muscles improves their elasticity and increases the rate at which they get rid of lactic acid.

Learn more Look at
Connective Tissue Stretching

The Ultimate Warm Up: Breathing

As I mentioned above, breathing is one of the frequencies that your microcirculation listens to and responds to in order to regulate our circulation.

How? Breathing techniques can work in two ways: by stimulating your parasympathetic nervous system or stimulating your sympathetic nervous system. Imagine getting into a cold bath: you quickly breathe in. Now, imagine getting into a warm bath: you relax by taking a big breath out.

When you exhale, you trigger your parasympathetic nervous system, and when you inhale, your sympathetic nervous system. You might notice that you sigh when you're stressed or when you feel relaxed. It is a way for your body to express comfort or soothe itself .

When you're scared, you hold your breath. When you are surprised, you quickly breathe in. Taking that exaggerated inhale sends a signal to your body to trigger the sympathetic nervous system, or the "fight and flight" system.

What about when we exercise?

We automatically begin to change our breathing patterns. It often takes a conscious effort to correct those patterns into breathing methods that benefit us (and our bodies) more. If we apply those same practices to regular breathing to "trick" the body into thinking it's undergoing more physical stress—for patients who can't undergo strenuous workouts—we can still perform relatively simple breathing exercises to tap into those same benefits.

Exhale and Inhale

We can use slow, long breaths to decrease stress, increasing the activation of the parasympathetic nervous system. This can help us reduce stress and increase gases that dilate blood vessels.

How? Breathing stimulates a pump that improves circulation and microcirculation.

Physiologically, several changes are taking place within the autonomic nervous system. **Inhaling is controlled by the sympathetic nervous system, while exhaling is controlled by the parasympathetic nervous system.** We're able to observe those changes through testing.

Heart Rate

One of the tests to evaluate a person's autonomic nervous system function is called the **"deep breathing test."**

For this test, the practitioner has the client lie down and breathe in for five seconds and breathe out for five seconds. The practitioner monitors the client's heart as they breathe.

In a healthy individual, inhaling results in an increased heart rate, while exhaling results in a decreased heart rate. Simultaneously, the reverse is true: inhaling and exhaling work to control and regulate the nervous system.

Vagus Nerve

Other tests show the direct connection between breathing and the vagus nerve.

The vagus nerve is the longest nerve of the autonomic nervous system. It comes out of the brain and travels down the neck into the chest. The vagus nerve helps control the heart lung and digestive tract. It is a main interface for the parasympathetic nervous system.

In one experiment, researchers electrically stimulated the vagus nerve, which resulted in a forced exhalation by the subject.

Exhaling stimulates the vagus nerve while Inhaling suppresses it.

The fact that we can directly impact the vagus nerve by modifying inhale/exhale patterns means we can tap into many opportunities to better control chronic illnesses. More specifically, it allows us to simulate change within the body through simple breathing techniques.

If you are in a panic state, your breathing rhythm becomes faster, As a result you'll spend proportionally more time inhaling than when in a calm state. Thus, our body's innate response to fear with faster breathing has an impact on brain function and results in faster response times to dangerous stimuli in the environment.

By slowing our breathing rate it offers a channel through which autonomic activity can be harmonized to improve both cardiovascular and psychological health. For example we know how bad an overactive sympathetic nervous system can be. We know that chronic diseases tend to have an increased sympathetic nervous system. By slowing your breath and increasing your time in exhale, you can lower your heart rate, increase digestion and improve peripheral circulation.

Chest vs Diaphragm Breathing

It's also important to understand the relationship between diaphragm breathing and thoracic breathing/ chest breathing.

It is helpful to group nose breathing and diaphragm breathing together. The smaller nose holes increase ventilation resistance and will help active the stronger breathing muscle of the diaphragm. Conversely mouth breathing has less resistance and tends to favor chest or thoracic muscles.

When oxygen demand is high during exercise or stress, the sympathetic nervous system becomes active, and thoracic respiration and mouth breathing goes up, and abdominal muscles and nose breathing are actively inhibited. When oxygen demand is low, in times of rest and digestion (the parasympathetic dominant state), the ratio shifts more towards abdominal respiration and nose breathing.

In an example, a runner began to breathe heavily due to the increase in oxygen demand. The sympathetic nervous system will kick in and activate thoracic respiration and mouth breathing. This increases the volume of ventilation and decreases respiratory resistance.

After the run the oxygen demand decreases and mouth closes and thoracic respiration turns off favoring parasympathetic diaphragm and nose breathing. Nose breathing increases respiratory resistance which activates the diaphragm and slows the breathing rate. It makes breathing cycles longer.

A long breathing cycle of six breaths per minute can evoke effects that are beneficial to cardiovascular health and recovery. Slow breathing enhances heart baroreflex sensitivity which are nerves in the heart that help it respond to blood pressure. There is a strong inverse relationship between baroreflex sensitivity and cardiovascular. Slow breathing also reduces muscle sympathetic nerve activity, attenuating hypertensive vasoconstriction, and blocks cardiovascular responses to physiological stress evoked by mild decrease of oxygen. Thus, health benefits might result from training people to breathe at approximately half the average resting rate. **The voluntary modulation of breathing rate therefore offers a channel through which autonomic activity can be shaped to improve both cardiovascular and psychological health.**

Nose-Breathing

Breathing through the nose results in increased “dead space” in the respiratory tract. That dead space is the “dead” air that must be removed before fresh air can enter the body.

Picture breathing through a snorkel: the longer the snorkel is, the more you have to inhale and exhale to receive fresh air from the surface. Breathing through your nose increases that snorkel length and doing so from the mouth decreases it.

When you exercise, you might feel a strong urge to breathe heavily through your mouth. This is your body trying to decrease the snorkel length, making it easier to exhaust the extra gases produced by exercising .

Exercise for Nose Breathing: Nitric Oxide (NO) increases from humming

A person of any age standing, sitting, or in a lying position—even on a hospital bed—can perform the humming exercises. Humming increases Nitric Oxide from your sinuses, nasal mucosa, and blood vessels.

NITRIC OXIDE REVIEW

Nitric Oxide is a Gas.
It passes through things easily and doesn’t last long
There are three producers of NO

Nervous

- Nervous product it to increase strength of nerve signal transmission and dilate blood vessels to bring energy to them

Blood Vessels

- Blood vessels produce it to dilate blood vessels mainly in response to sheer stress on there walls or muscle or organs needing blood

White Blood Cells

- White Blood cells produce it because it can kill bad things and increase blood so other things can help kill bad things.

Too Much Is Bad

Excessive NO production from inflammation contributes to several Neurodegenerative diseases, Multiple sclerosis, HIV dementia, Brain Ischemia, Trauma, Parkinson’s disease, and Alzheimer’s disease.

Too Low Is Bad

Fatigue or low energy levels.
High blood pressure or decreased heart function
Loss of libido (sex drive) or Erectile Dysfunction

Nitric Oxide contributes to your body's defenses against bacterial, viral, fungal, and parasitic infections. It improves the ventilation-perfusion ratio in the lungs, along with the relaxation of bronchial tree smooth muscles. With NO, your oxygen intake is increased and you can find relief from bronchial asthma.

Produced endogenously from the blood vessels and mucosa, NO is naturally produced in our youth and reduces while aging. This can disrupt the blood circulation to the ear, brain, heart, and sex organs.

Humming can increase the endogenous generation of NO by 15-fold as compared with the quiet exhalation.

Because of its vasodilator effect, NO can control the filling of nasal vessels and airflow, nasal mucosal temperature, and humidification. This is like air conditioning for your sinuses and respiratory passage.

It affects the ciliary flow and cleansing of your nose, paranasal sinuses, and nasopharyngeal tubes. Better airflow in the nasopharyngeal tubes can also improve ventilation in the middle ear, resulting in an improvement in the quality of hearing. The NO generated during humming, by improving the Eustachian tube function and cochlear blood flow regulation.

How does it work? Nitrite is converted into NO by macrophages and endothelium of the respiratory mucosa, which dilates the vessel.

The endothelium then releases more NO while performing physical activity

Stress, like that when watching a horror movie, reduces the release of NO. Comedy movies, on the other hand, increase the NO level. Apart from calming the brain by improving the quality of sleep, NO helps memory and behavior by transmitting information between neurogenic cells in the brain.

NOSE BREATHING CAN

1) Increase resistance in our airways which helps activate the diaphragm.

2) Increase our airways dead space, and retention of Co2 and NO.

3) Decrease stimulation of our irritant receptors by warming and humidification.

Mouth breathing and forward head posture

Various studies assess body posture in mouth-breathing subjects. The consensus is that forward head posture is a major change. This forward head posture can lead to disorganization of the muscle and impairment in diaphragm muscle mobility and function.

These inefficient respiratory muscle functions will also decrease respiratory muscle strength over time, resulting in reduced chest expansion and impairing breathing during physical activity. This postural change also leads to accessory muscle recruitment, with increased sternocleidomastoid muscle activity, causing rib cage elevation, reducing thoracoabdominal mobility, and compromising the efficacy of the diaphragm. This mechanical disadvantage intensifies the inspiratory effort and increases the work of breathing.

This is why Most people with chronic neck pain will be mouth breathers. Only after switching to nose breathing are they able to maintain relief from therapies like massage chiropractic or acupuncture.

Mouth Breathing also increases the episodes of exercise induced asthma.

In a study done on nasal and oral breathing during moderate treadmill exercise to the onset of bronchoconstriction in young patients with perennial bronchial asthma, most subjects spontaneously breathed with their mouths open when instructed to breathe "naturally."

Subsequently, when required to breathe only through the nose during the exercise, almost complete inhibition of the postexercise bronchoconstrictive airway response was demonstrated. When instructed to breathe only through the mouth during exercise, an increased bronchoconstrictive airway response occurred. These findings suggest that the nasopharynx and the oropharynx play important roles in exercise.

Hypo- vs. Hyperventilation

Hypoventilation (breath-holding) and hyperventilation (over-breathing) are two ways to influence the cellular respiration process and circulation.

While hypoventilation and hyperventilation are potentially dangerous when performed incorrectly, they can both modulate cellular respiration circulation patterns.

For normal, healthy functioning, the body requires a certain amount of both oxygen and carbon dioxide. It is widely recognised that oxygen is a gas essential to life, but many people are surprised to hear that carbon dioxide is not just a waste gas. In terms of breathing, the two work hand in hand.

Carbon dioxide performs a number of vital functions in the human body, including:

- **Offloading of oxygen from the blood to be used by the cells**
- **The dilation of the smooth muscle in the walls of the airways and blood vessels**
- **The regulation of blood pH**

When we take a breath of fresh air into our lungs, oxygen passes from the lungs to the blood where it is picked up and carried through the blood vessels by a molecule called haemoglobin. This oxygen-rich blood is then pumped by the heart throughout the body so that oxygen can be offloaded to cells for conversion to energy. In order to release oxygen from the blood, however, haemoglobin requires a catalyst, which involves the presence of carbon dioxide (CO_2).

Physical exercise is a perfect example of these conditions: when we move our muscles, the body requires more oxygen to give us energy and perform at a higher intensity. During exercise, body temperature increases and cells produce carbon dioxide, allowing extra oxygen to be released by the blood to the muscles and organs.

The concentration of carbon dioxide in the blood is determined by our breathing. hyperventilation breathing in excess of bodily requirements causes too much carbon dioxide to be exhaled from the lungs, which in turn causes a reduction of the concentration of CO_2 in the blood and cells.

When carbon dioxide levels are less than adequate, the transfer of oxygen from blood to muscles and organs is limited, leading to poor body oxygenation.

When we hold our breath or hypoventilate, there is an increased pressure of carbon dioxide in the blood, pH drops and oxygen is released more readily. Conversely, when carbon dioxide levels are low, haemoglobin molecules are less able to release oxygen from the blood. The way we breathe determines the amount of carbon dioxide present in our blood, and therefore how well our bodies are oxygenated.

In addition to determining how much oxygen is released into your tissues and cells, carbon dioxide also plays a central role in regulating the pH of the bloodstream: how acidic or alkaline your blood is.

Scientific evidence clearly shows that carbon dioxide is an essential element not just in regulating our breathing, optimizing blood flow, releasing oxygen to the muscles, but also maintaining correct pH levels.

Hyperventilation

Hyperventilation means breathing faster than your body needs. When we do this we decrease the level of Carbon dioxide in our blood and stimulate our sympathetic nervous system. **Both of these things will cause vasoconstriction and decrease body-wide blood flow. .**

This vasoconstriction reduces blood flow to tissues and organs including the heart and brain which can cause a feeling of dizziness and light-headedness.

Hyperventilation will activate the sympathetic nervous system and decrease Co2 levels resulting in epinephrine release, vasoconstriction and suppression of immune response. These results could have important implications for the treatment of conditions associated with excessive or persistent inflammation, such as autoimmune diseases.

Hypoventilation

When you hold your breath or hypoventilate, carbon dioxide levels rise. Meanwhile, your oxygen level continues to decrease as it's used to create ATP.. That carbon dioxide is a vasodilator, which means **holding your breath boosts body-wide blood flow.**

Researchers have observed a 5% increase in carbon dioxide and up to 70% increase in blood flow in brain circulation studies. A 7% increase in carbon dioxide can increase cerebral blood flow by 100%

However, moderation is key: Modest hypoxia most often leads to beneficial effects without pathology. Severe hypoxia like sleep apnea can increase the risk of health problems, like high blood pressure, stroke. heart failure, irregular heart beats, and heart attacks. Headaches, depression etc.

In striking contrast, low-dose hypoxia can:

- **reduce arterial hypertension**
- **strengthen innate immune responses**
- **reduce inflammation**
- **reduce body weight**
- **increase aerobic capacity**
- **improve learning and memory**
- **rescue poor blood flow-induced memory impairment**
- **reduce symptoms of depression**
- **improve postischemic recovery of myocardial contractile function**
- **increase respiratory capacity in Chronic obstructive pulmonary disease**
- **increase respiratory and nonrespiratory somatic motor recovery following spinal injuries in rats and humans).**

Effect of Breath-Holding on Cerebral Blood Flow

The brain's high metabolic demand and bleak energy storage make hypoxemia a critical challenge for cerebral functioning.

How? You can see this when there is the complete and abrupt cessation of cerebral oxygen supply. It results in unconsciousness within **4–6 seconds** and brain death within just a few minutes.

Cerebral blood flow regulatory systems are dynamically active during breath holds. During a dry, static breath-hold in most elite divers, the net result is a peak increase in global cerebral blood flow by **70 to 110%**.

An increase in cerebral blood flow during a breath-hold occurs mainly from hypercapnia (high co2 levels)- and hypoxemia-induced pial artery (intracranial vessel) dilatation. And when combined with hypertension, the subsequent increases in perfusion pressure.

However, the mechanisms responsible for increasing the cerebral blood flow are in continual competition with other factors, like the sympathetic nervous system's profound excitement and increased intracranial pressure.

The vasoconstrictor impact of cerebral sympathoexcitation during breath hold is not absolute. However, it might prevent cerebral hemorrhaging associated with the large increases in cerebral blood volume and arterial pressure.

Effect of Breath-Holding on Spleen

Spleen volume decreases during short breath-hold (apena) in healthy adults.

The spleen serves as a reservoir of blood cells. It releases them into the central circulation in response to physiological stresses such as exercise and apnea.

The spleen contraction results in increased circulating hemoglobin and decreased spleen volume. Breath-holding has been shown to reduce spleen volume

In humans, the spleen contains around 200–250 ml of densely packed blood cells and ~8% of the total body red blood cell pool Compared with a 50% splenic content of Red Blood Cell in seal the splenic red blood cells reservoir function is not well developed in humans. The White Blood Cell reservoir is much greater, 40% of the body's population of granulocytes and platelets pool The physiological implications of the spleen as the reservoir of various blood cells.

Spleen Volume and Blood Flow

How does it work? The spleen's contraction can cause an increase in the circulation of hemoglobin and hematocrit to enhance oxygen transport during a breath-hold. The contraction's magnitude depends on the duration and whether the breath-hold is performed underwater or with facial cooling.

At the end of a ~5 min dry static breath-hold in elite panelists, splenic contraction caused circulating venous hemoglobin and the hematocrit to increase by ~4%. Meanwhile, following five consecutive static breath holds with the face immersed in cold water (with 2 min rests in between), the venous concentration of white blood cells increased by 15%.

The splenic contraction was only a bit greater in trained than in untrained persons, suggesting that apnea training doesn't influence the spleen's ability to participate in the diving response very much. Once the spleen had contracted, it took 8 minutes for its full recovery after a single apnea and 1 hour after 5 breath holds.

Compared with the 50% splenic content of RBC in a horse and a seal, it appears that splenic

RBC reservoir function is not well developed in humans. Up to 50% of this thick blood is transferred to active circulation during maximal exercise or apneic diving

What does the spleen do? The spleen contracts immediately on the onset of breath hold There is also an increase in heart rate. This rapidity of the splenic response to apnea diving argues against peripheral triggers and favors a centrally mediated feed-forward mechanism.

Besides exercise and diving, the spleen emptying may involve periods of obstructive sleep apnea.

Spleen Summary

- **It doesn't matter the type of breath-holding**
- **The spleen contracts immediately on the onset of breath hold, a rapid process with an active contraction that lasts less than 30 sec.**
- **Spleen probably releases more WBC than RBC. The splenic RBC reservoir function is not well developed in humans.**
- **The spleen is a reservoir of various blood cells.Granulocytes and platelets pool in the human spleen to a much greater extent than RBC.**

The Ultimate Warm Up: Hydrotherapy

Hydrotherapy

Hot and cold water work in similar ways to exercise by triggering vasodilation and constriction.

The simplest form of hydrotherapy is taking a hot and cold shower. This is something you can do at home to engage your nervous system and trigger vasoconstriction or dilation.

Cold showers shouldn't be freezing, but they should be cold enough to feel invigorating. Research shows that even moderately cold temperatures still provide benefits.

Cold

Applying cold water stimulates the kidneys and adrenal glands. This stimulation can create vasoconstriction (the shrinking of your blood vessels). It is helpful in pain management because it reduces the amount of blood flow to painful areas.

Ice-cold water is also known to trigger an SNS response (fight-or-flight). This response releases endocannabinoids in the brain, which is the same mechanism behind the euphoria known as "runner's high." The release of adrenaline and endocannabinoids are two reasons that cold showers can be great for people feeling depressed or have a hard time getting out of bed.

If cold showers don't sound appealing, here's a tip: Start your shower warm. Then slowly and incrementally, turn the water to a colder temperature. By doing so gradually, you allow your body to get used to the cold water, rather than shocking your system all at once.

Holding your Breath with Face in Cold Water (The Dive Response)

When you hold your breath underwater, your body tries to maintain consciousness oxygen conservation (central blood flow distribution and attenuated oxidative metabolic rate).

This principle comes from the cardiovascular and metabolic adjustments in the mammalian dive response.

The mammalian dive response leads to vagus nerve controlled bradycardia (slow heart rate) and sympathetically mediated spleen contraction and peripheral vasoconstriction.

Your heart rate slows down, your blood gets pulled into the core, and your spleen contracts and releases more red and white blood cells. These all depend on facial cooling from the water and are not just typical breath holds.

Heart Rate During a Breath Hold

At the latter part of a prolonged breath-hold in cold water, heart rate may reach as low as 20–30 beats min−1 in elite free divers. This results in a benefit of reduced oxygen consumption and a slower rate of total oxygen desaturation.

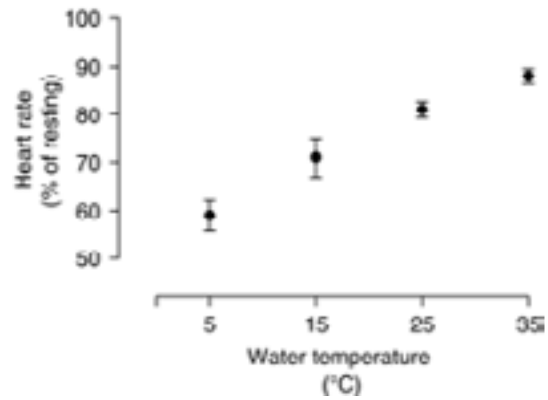
The magnitude of the bradycardia response to breath-holds depends on the extent of facial cooling. It's also important to note that facial cooling without a breath-hold does not cause bradycardia.

A person's mental state can also play a role where mental stimulation prevents Bradycardia during a breath-hold. The diving reflex can be modified by higher nervous stimulation. The effect is dependent on mental challenges, such as that provoked by arithmetic. So it is important to remain calm and relaxed to increase the dive response reflex.

Trigeminal Stimulation

The Trigeminal nerve responsible for sensation in the face and motor functions such as biting and chewing.

Upon stimulation, the trigeminal nerve starts a well-established 'trigeminocardiac reflex'. This reflex is characterized by slowing heart rate, decreased blood pressure, stomach hypermobility, and cerebrovascular vasodilatation. The leading influence of trigeminal stimulation is the different HR responses to breath-holding with varying water temperature during facial immersion *(Figure 3)*.The colder the water, the better the trigeminal response.



Bain, Anthony R., et al. "Physiology of static breath holding in elite apneists." Experimental physiology 103.5 (2018): 635-651. Heart rate responses during breath holds with different levels of facial cooling. The magnitude of bradycardia is inversely proportional to the water temperature/facial cooling. Figure adapted from Gooden (1992); data are derived from the average of seven separate studies (see Gooden (1992) Gooden, Brett A. "Why some people do not drown: Hypothermia versus the diving response." Medical journal of Australia 157.9 (1992): 629-632.

Effect of Breath-Holding Peripheral vasoconstriction

More recent data confirm an increase in activity in the SNS mainly responsible for increased peripheral vasoconstriction and decreased peripheral blood flow. These studies show that the magnitude of peripheral vasoconstriction and blood flow centralization depends largely on breath-holding conditions.

The magnitude of the increase in muscle sympathetic nerve activity is most extensive when a breath-hold is combined with facial cooling.

Hot

On the contrary, hot water creates vasodilation (the expanding of your blood vessels).

Vasodilation promotes healing by increasing blood flow to that particular area. It also improves heart function and helps treat Chronic obstructive pulmonary disease. An increase in blood circulation to the brain can also help patients who have Dementia or Alzheimer's.

Foot Soaks

The sheer act of placing your feet in warm or hot water warms your feet, aids in relaxing fascia, and dilates the blood vessels in your feet and lower legs (which is very important)

There is a saying of unknown origin "Cold Head and Warm Feet"

Cold is heavier than hot and will tend to sink. Hot is lighter than cold and will tend to rise.

Some sage worked out that in order to maintain our health, we need to somehow take the warm energy from above and get it to circulate down below. We also need to take the cold energy below and get it to circulate above. In fact, this process of (re)circulating and mixing is life itself. A cold head and warm feet is a good sign of a properly working circulatory system.

Unlike our ancestors, many people today live relatively sedentary lifestyles, which creates less blood flow throughout the body. Additionally, this lack of movement plus chronic stress can increase muscle stiffness as we age, especially in our feet. It leads to close feet and hot heads.

Foot soaks can help increase the heart rate as if you would be exercising, which is essential for those of us who can't run and jump like we used to. Having the ability to do cardiovascular exercise and break a sweat is crucial for getting our bodies' processes back on track.

Here's how to optimally do a foot soak and how it helps our bodies:

STAGE 1

Initially, you put your feet in the water. The water should be at a hot temperature but still safe for you to use. The heat itself will signal the body to dilate blood vessels. This allows all of the tissue in the area to become oxygenated.

Think of your body like a snow globe. Anything outside the cells will drain downward, draining down into the legs and feet. You can imagine that the sediment builds up sediment and rots there. This build-up causes oxidative damage to the body through an inflammatory reaction.

Vasodilation can also lower blood pressure for those who want a nice foot soak for a tranquilizing effect.

If you need help getting to sleep, then do a foot soak but just allow your feet to get warm. You have to stop before the heat travels throughout the whole body. If you have high blood pressure, you want to do a shorter foot soak, too.

STAGE 2

During the next stage, the heat will begin to rise in the legs. The first time you do a foot soak, the heat may only rise halfway up your shin. However, as your vasculature improves, you'll gradually be able to feel the heat past your knees, through the hips, and to the lower back.

At this point, we'll see a lot of healing taking place within the knees and the lumbar area. You should expect this stage to bring you pain relief.

STAGE 3

As the heat continues up toward the chest and heart, you might begin to feel an increase in your heart rate.

Doing a prolonged foot soak to increase the heart rate is not ideal for those who have high blood pressure. However, if blood pressure is not a problem, allowing the heat to go up and cause the heart to beat faster can be an excellent thing. It can increase the body's energy and activate that mitochondria to get that same exercise-induced cardiovascular effect.

STAGE 4

The foot soak's final stage is when the heat will travel up through the head and cause the person to break a sweat.

After you break a sweat, this is a great time to dry your head and feet and leave the bath.

Drinking Water

Blood primarily consists of water. Drinking water is a great way to combat circulation issues.

The mechanisms by which fluids may improve microcirculation are not well understood but could be related to **decreased viscosity, white blood cell adhesion, and endogenous vasoconstrictive substances.**

Dehydration can negatively affect your organs and bodily functions, including your heart and cardiovascular system.

When you are dehydrated, your blood volume, or the amount of blood circulating through your body, decreases. To compensate, your heart beats faster, raising your blood pressure. When you're dehydrated, your blood also retains more sodium, thickening your blood and making it harder for your blood to circulate through your body.

Keeping your body hydrated helps your heart pump blood more efficiently and allows oxygen to reach your muscles, helping the muscles work efficiently.

Conclusion Stuff

Conclusion

Microcirculation is a powerful indicator of health. When it is functioning well, our body's market places of exchange have access to all the supplies they need and can easily get rid of the waste products they don't. When it becomes impaired through lifestyle or disease we can develop traffic jams and find ourselves feeling awful and frustrated without really knowing why.

One of the best ways of improving microcirculation is by improving vasomotion. Vasomotion is the traffic lights of our circulatory roadways. It responds and adjusts perfectly to, not only the local coming and going of traffic, but to the system wide flow.

The way that we can affect vasomotion is by improving its oscillatory frequencies. We can use breathing and movement techniques to balance our autonomic nervous systems which tend toward sympathetic dominance in chronic illness and stressful lifestyles. By using simple exercise and hydrotherapy we can improve blood circulation, balance nitric oxide and prostaglandins in our body, while avoiding the negative vasoconstricting effects of the sympathetic nervous system.

This guide was written to explain microcirculation and vasomotion. After reading this guide, you should now understand the different ways in which these processes affect you and how you can affect them. It's essential to see how such tiny capillary beds in our body can significantly impact how our bodies function. You also should have learned how synchronized your system works and how each small moving part affects the other.

My guide's purpose was to show you how to use different techniques to affect various oscillation or vasomotion frequency levels. I wanted you to learn how to stimulate all levels of microcirculation.

Extra tips Guidelines and Goals

Don't Wear Yourself Out

For most people, the goal of a good workout is to push your body just past its limits. That's when you know that your body has been adequately stressed. And with rest, can then enter into a state of recovery, building up stronger muscles.

But for people who are chronically ill, that "worn-out" point is the danger zone. You have learned that an increased sympathetic tone impairs your recovery phase. Since your body is already trying to cope with a chronic state of illness, it'll struggle even more to recover from the added stress of working out.

Moderation is Key

So how do you achieve your exercise goals if you can't push yourself past the point of comfort? Moderation.

If you have a goal of increasing your walking from three miles to four miles this week, don't pack all four miles into one day. Instead, break those four miles up into the smallest increments you can. You might walk half a mile in the morning and half a mile in the evening. Slow and steady is best!

Also take frequent breaks. If your microcirculation is poor, it will deprive your muscles of the oxygen and nutrition it needs. Stopping and taking breaks allows muscles to recover. Example: between exercises stop and shake and hum. Long slow exhale will increase Nitric Oxide and decrease

vasoconstriction of the sympathetic nervous system

This way, you'll be less likely to become worn out, and you can still push yourself toward a higher goal. As your tolerance for exercise increases, you'll be able to walk longer distances without risking exhaustion.

If you do strenuous exercise during your workout, take the time to slow your breath and recover before moving on to the next movement.

Good Days and Bad Days

Some days we may feel healthier than others. At certain times of the day, we may feel stronger and more capable of exercise than others.

The good news is, you schedule your exercise. Try to keep your activities within these "good" times and decrease exercise stress on the "bad" ones. The important thing is to listen to your body, especially when it needs all of its energy reserves to rest and heal.

Know Your Goal

It's critical to remember your goal when engaging in physical activity, even if it isn't strenuous work. If you start to feel like a particular workout isn't giving you the benefits you want, it may be time to try another method.

These exercise alternatives can give you the benefits of exercise like improved blood flow, lowered cholesterol, and enhanced mood.

Cheat-Sheet

Use the "cheat-sheet" below to help you quickly remember how each exercise affects the body.

With all this new understanding, I invite—and encourage—you to experiment by adjusting these techniques and powerful exercises to better meet your needs.

*You can Purchase **The Ultimate Warm Up***

Six simple, low-intensity activities for less pain, less risk, and more comfort in your body.

Over two weeks, we'll send you a video every other day with an easy, low-intensity exercise alternative to try out.

Exercise doesn't have to be intimidating. That's why Will Sheppy, licensed acupuncturist (LAc) and founder of Valley Health Clinic, created this video series of easy exercise alternatives that anyone can do.

Better circulation, less pain, a balanced nervous system, and increased bone and muscle health are just a few of the benefits of a daily exercise routine, and *The Ultimate Warm-Up* is built for every body.

Exercise	Specific Therapy	Effects	Good for...
Qi	Qi movement out and down	• Vasodilation • Promote yin/Lung • PNS	
	Qi movement in and up	• Vasoconstriction • Promote yang/LR • SNS	
Breath	Nose-breathing	• Increased carbon dioxide and nitric oxide • Increased PNS/Diaphragm	Exercise induced Asthma
	Mouth-breathing	• Decreased carbon dioxide and nitric oxide • Increased SNS/Chest	
	Exhale	• Decreased HtR • Increased PNS • Promote yin (in)	Decreasing Stress

	Inhale	• Increased HtR • Increased SNS • Promote yang (out)	Depression waking up motivation
	Hypoventilate	• Increase carbon dioxide • Decrease oxygen • Increase vasodilation • Increase SNS	Early phase of exercise and recovery
	Hyperventilate	• Decrease carbon dioxide while maintaining the same oxygen level • Increase vasoconstriction • Increase SNS	Later stage exercise and recovery
Body	Vibration Shaking	• Increased nitric oxide • Increase vasodilation • Decrease SNS	Bone health Decrease stress and shoulder tension cold hands and feet
	Vibration Patting	• Increased nitric oxide • Vasodilation in the skin • Muscle vasodilation • Decrease SNS	Skin hands immune system Digestion Cold hands and feet
	Cold on the Body	• Increased SNS vasoconstriction	Pain and depression Stimulate KD
	Cold on the Face	• Increased PNS vasoconstriction • Lower Heart Rate Increase effect with breath hold	Sleep
	Warm on the Body	• Increased PNS vasodilation	Stimulate Brain and heart
	Warm on Feet	• Lower BP	