



HEALTH  
MEANS®

**10 Ways to**  
**SUPPORT YOUR**  
**LYMPHATIC SYSTEM**

by HEALTHMEANS

# CONTENTS

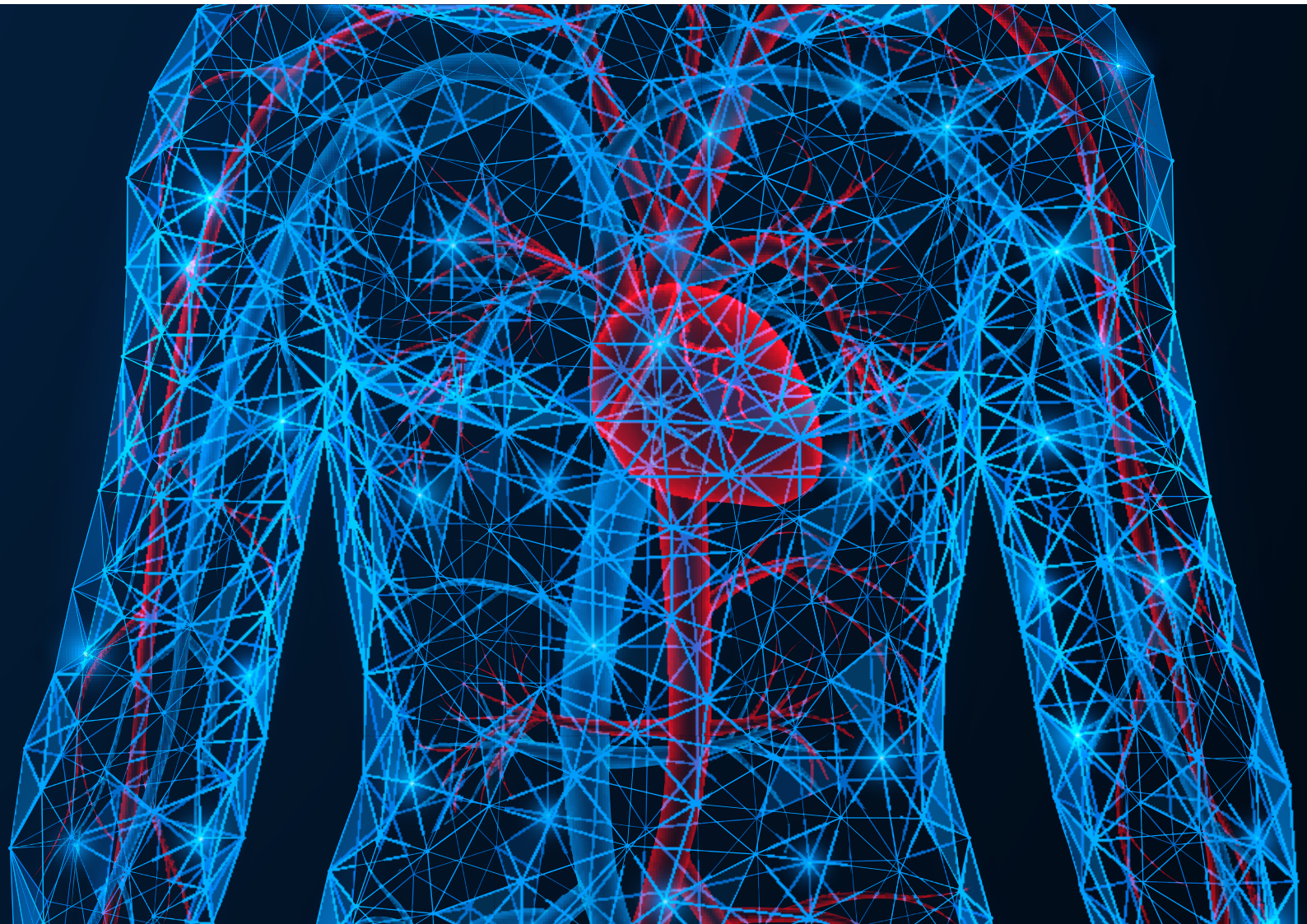
3	Introduction
4	Parts & Functions of the Lymphatic System
6	The Three Primary Jobs of the Lymphatic System <ul style="list-style-type: none"><li>Circulation of Fluid</li><li>The Highway of the Immune System</li></ul>
7	A Transporter for Fat
8	Lesser-Known Roles of the Lymphatic System <ul style="list-style-type: none"><li>The Lymphatic System in the Brain</li></ul>
9	The Lymphatic System and Metabolic Balance
10	Lymphatic System Support <ul style="list-style-type: none"><li>Movement</li></ul>
11	Deep Breathing
12	Compressive Garments
13	Dry Brushing
14	Godoy and Godoy Method
15	Castor Oil
16	Hydrotherapy
17	Eat Healthy Fats and Proteins
18	Stay Hydrated
19	Lymph-Supporting Foods and Herbs
21	References

# INTRODUCTION

We're well aware of many body systems; we can feel our hearts beating and, in some circumstances, our blood pumping through our veins. We can perceive the churning of our stomachs and hear gurgling as our food is digested. The nervous system's intricate pain and pleasure sensations dictate our knowledge of what's safe or dangerous and help us make sound decisions. Even the workings of nutrient metabolism are familiar to us—hunger, satiety and energy levels tell us when it's time to eat, fast or rest.

But what about the lymphatic system? This exquisite immune-mediated network underlies multiple physiological functions, but we rarely recognize that it exists.

In this eBook, we'll review the anatomy and physiology of the lymphatic system, along with its close connections to the cardiovascular system, the digestive system, the nervous system and our metabolic function. We'll also learn practical dietary and lifestyle tips that will help us support this critical hidden highway. Let's get started!



# PARTS & FUNCTIONS OF THE LYMPHATIC SYSTEM

The most fundamental components of the lymphatic system are the cells. Lymphatic cells include cells that we associate with the immune system, and for a good reason! The lymphatic system is technically part of the immune system and contains cells such as lymphocytes (B cells and T cells), macrophages and dendritic cells.

Lymphatic cells eventually become part of lymphatic fluid. But where does lymphatic fluid originate?

Lymphatic fluid, also known simply as lymph, begins as interstitial fluid. Interstitial fluid is a body-wide fluid found outside of our cells that originates from *normal* blood capillary leakage.

Our blood capillaries, the smallest branches of the cardiovascular system, connect the vessels that carry blood away from the heart (the arteries) with the vessels that return blood to the heart (the veins). These tiny, numerous, thin-walled capillaries essentially act as a bridge between the bloodstream and our tissues. They allow oxygen and nutrients in the blood to reach our organs. But they also allow immune cells and waste products to move away from our organs in the form of interstitial fluid.

The interstitial fluid contains all the byproducts of tissue and organ function. It is generally composed of water, sugars, salts, fatty acids, hormones, neurotransmitters, amino acids, coenzymes (such as vitamins and minerals) and cell waste products. Keep in mind that the composition of interstitial fluid varies based on the nearest tissues or organs and their specific physiology.

Once enough interstitial fluid has accumulated, pressure changes shuttle the fluid into lymphatic capillaries, which are larger in diameter than blood capillaries. Once the interstitial fluid enters the capillaries, it is known as lymph. These lymphatic capillaries are minuscule, one-way valves located between our cells that eventually converge into larger lymphatic vessels that, similar to a string of pearls, are “strung” with the more commonly known lymph nodes.



Our bodies contain between 400 and 600 bean-shaped lymph nodes, primarily concentrated in the neck, chest and breasts, armpits and groin. For most of us, these organs are the most familiar parts of the lymphatic system—colds, flu and other infections or diseases can lead to swollen and sometimes painful lymph nodes that are easily felt under the skin. While these symptoms aren't enjoyable, they're a signal that the immune system is hard at work protecting us from illness.

All lymph fluid passes through at least one lymph node, with the node acting as an essential immune checkpoint. Any harmful viruses, bacteria or other antigens present in the lymph are dutifully addressed by concentrated amounts of white blood cells—specifically B cells (commonly known as antibodies), T cells, dendritic cells and macrophages—all present in the lymph node. So, if we're fighting an infection, our lymph nodes may become inflamed due to an appropriate immune response.

From the lymph nodes, the one-way journey of the lymph continues into more extensive areas of lymphatic tissue, called trunks, and then into two lymphatic ducts. Multiple lymphatic trunks drain lymph from various areas of the body, such as the lumbar trunk, intestinal trunk and the jugular trunk. However, all lymph is eventually passed to one of two ducts, the right lymphatic duct or the thoracic duct. These ducts connect the lymphatic fluid back to the bloodstream, and the cycle of interstitial fluid formed from blood capillary leakage begins again!

However, the lymphatic system is more than the capillaries, vessels, nodes, ducts and trunks. There are also six lymphoid organs. These organs either create the white blood cells and tissues present in the lymphatic system or act as containers for these cells while fighting off germs, viruses and other antigens.

The bone marrow and thymus are lymphocyte (B cell and T cell) factories. Both B and T cells are created in the bone marrow. T cells, however, migrate to the thymus, located directly under our sternum in the upper-middle section of our chest, for further immune-focused training.

The spleen, tonsils and specialized mucous membranes, such as the more well-known GALT (gut-associated lymphatic tissue) in the intestines, join the lymph nodes as sites of lymphatic system action. These organs all act as immune "filters." Large amounts of white blood cells present in lymphoid organs monitor our blood, food and lymphatic fluid for potentially harmful invaders. The spleen, tonsils, specialized membranes and lymph nodes collaborate with the system-wide action of the lymphatic vessels to keep our entire body safe.

# THE THREE PRIMARY JOBS OF THE LYMPHATIC SYSTEM

## CIRCULATION OF FLUID

The lymphatic system is responsible for three major actions in our body.

First, as we've just learned, it's in charge of the draining and recirculation of interstitial fluid from extracellular spaces. This integral role is so closely linked with cardiovascular function that we would not be able to maintain blood volume without the lymphatic system!

While we have probably never considered the extreme importance of optimal blood volume, imagine what would occur if our blood wasn't able to bring oxygen and nutrients to our cells or remove and dispose of waste products. Both high and low blood volume are problematic, and the lymphatic system underlies the delicate balance that keeps our cells and tissues fueled and functioning properly.

## THE HIGHWAY OF THE IMMUNE SYSTEM

Next, remember the role that the lymphatic system plays in our immune function. The tissue that makes up the lymphatic capillaries, vessels, nodes, etc. is actually a form of highly specialized immune tissue that contains large numbers of white blood cells called reticular connective tissue. In essence, every drop of lymph that passes through lymphatic vessels and nodes is monitored by the immune system—consider the lymphatic system the highway of our immunity.

The cells of our immune system are constantly "sampling" every compound that we interact with, even our own cells. Viruses, bacteria, and fungi, along with food and self-proteins, pass through the incredibly refined differentiation process facilitated by the immune system. Our immunity classifies all these compounds as either dangerous or safe.

Once we're exposed to anything that the immune system deems as dangerous, such as an infectious bacterium, it is taken up by immune cells and, through the lymphatic vessels, brought to a lymph node. Think of the lymph node as the Grand Central Station of antigen and immune cell interactions. Deep within the nodes, problematic compounds are presented to our adaptive immune cells, and, if necessary, our immune system begins its attack to protect us from harm.

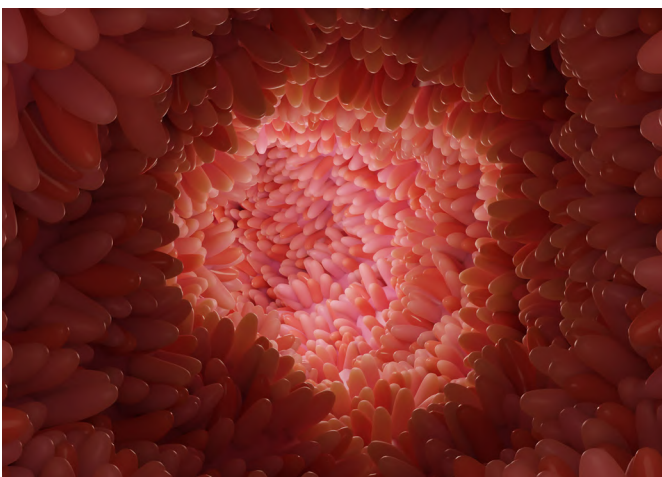
Our lymphatic system also participates in maintaining self-tolerance. As mentioned previously, the immune system samples all compounds, including the food we eat and our own cells. However, a response of tolerance versus attack is clearly necessary to keep our cells from becoming immune targets. Complex interactions within lymphatic vessels and nodes play a role in the important self-recognition process. Issues with self-recognition can lead to autoimmunity [1].

## A TRANSPORTER FOR FAT

Finally, one of the first known and most widely studied functions of the lymphatic system is the transport of dietary lipids and lipid-soluble vitamins A, D, E and K. While it was once thought to act as a simple conduit for fatty acids, the lymphatic system is now viewed as an active transporter and regulator of this critical macronutrient.

Our dietary fats are digested and absorbed through an intricate process of emulsification and reformation into triglycerides. These triglycerides are then formed into big biological packets of fat, fat-soluble vitamins, cholesterol and lipoproteins called chylomicrons.

Chylomicrons are lipoproteins similar to the more familiar low-density lipoprotein, or LDL, and high-density lipoprotein, or HDL, that we often find on routine blood tests. Chylomicrons, however, are known as *ultra* low-density lipoproteins, and they are the most buoyant and largest in size of all lipoproteins. Their large size makes it impossible for them to directly enter blood capillaries for transportation through the bloodstream. Thankfully, they can easily enter and be transported by the lymphatic system.



Amazingly, the lymphatic system has unique vessels for fat transportation called lacteals. These vessels are only located in the small intestine's villi, tiny hair-like projections that are the main areas of nutrient absorption. Lacteals absorb our digested dietary lipids, now packaged as chylomicrons, and transport them to the bloodstream where they are used for energy or are stored for future use [2].

# LESSER-KNOWN ROLES OF THE LYMPHATIC SYSTEM

Even though the lymphatic system is most known for its primary jobs discussed above, it also plays roles in our neurological function and metabolic balance.

## THE LYMPHATIC SYSTEM IN THE BRAIN

Until 2015, we believed that the lymphatic system did not extend to the brain. The brain was considered an “immune-privileged” area of the body, and scientists puzzled over how waste products were cleared from our nervous system. Interestingly, accounts of brain lymphatics exist from over 200 years ago in the work of Italian anatomist Paolo Mascagni’s publication on the lymphatic system. And more recently, studies from 1948 to 1996 explored and described lymphatic function in the meninges area of the brain, specifically the dura mater [3].

These works were overlooked until 2015, when two unassociated labs published rodent studies showing evidence of lymphatic anatomy and action in the brain. Now, the rediscovered neuro-lymphatic system is being studied for its role in neurodegenerative diseases, along with our ability to learn, sleep and adjust to stress. It’s also investigated due to its connection to the *glymphatic* system, a separate but adjacent waste removal system located in perivascular channels, small spaces filled with cerebrospinal fluid that surround the arteries and veins in the nervous system. The function of the glymphatic system, assisted by glial cells (thus, glymphatic system), is interconnected to the function of the brain’s lymphatic system, with the lymphatic system dominating fluid movement throughout the day and the glymphatic system taking over at night. This glymphatic-lymphatic tag team helps clear the dementia-associated protein amyloid-beta, as well as other proteins that may contribute to neurodegenerative diseases [4,5].





# THE LYMPHATIC SYSTEM AND METABOLIC BALANCE

The lymphatic system also contributes to our metabolic balance. Due to its roles in fatty acid transportation and regulation and immune activity, dysfunction of the lymphatic system may affect these areas of our physiology. Amazingly, obesity, insulin resistance, type 2 diabetes, cardiovascular disease and generalized inflammation may all be connected to a compromised lymphatic system.

Lymphatic vessels help control our dietary fat absorption and cholesterol balance via the removal of cholesterol in the interstitial tissues, called reverse cholesterol transport. However, rodent and gene studies show that defects in lymphatic development and impaired lymphatic function play roles in obesity, while obesity may lead to lymphatic abnormalities that are reversible with dietary changes and weight loss [6]. In essence, it may be that the lymphatic system and obesity are in an unfortunate inflammatory cycle.

Lymphatic endothelial cells, which form the very structure of lymphatic capillaries, vessels and nodes, may be key in the incredibly complex steps of insulin signaling and thus glucose uptake into cells.

Lymphatic endothelial cells, or LECs, express insulin receptors, specialized proteins that exist on cell membranes. These receptors work with signaling proteins, or substrates, to allow the entry of glucose into many of our body's tissues.

As with obesity, insulin resistance and diabetes may lead to dysfunctional lymphatic structures, function and increased inflammation. For instance, rodent studies have shown that diabetes may lead to an increase in the flow of lymph due to an excess of glucose and pressure in the interstitial tissue. Additionally, other studies have found that diabetic lymph nodes might be less able to uptake lymphatic fluid. Lymph abnormalities may then circle back to insulin resistance, forming a detrimental cycle. The cross talk between LECs and insulin signaling affects both systems [6].



# LYMPHATIC SYSTEM SUPPORT

The lymphatic system is a silent and unexpected influencer of many bodily functions. But how do we best support it? In the next section, we'll cover the top ways to keep our lymphatic system in fantastic condition.

## MOVEMENT

One of the most critical lifestyle choices we can make for the health of our lymphatic system is to keep moving. When we move, our lymphatic fluid moves too. Amazingly, during sustained, lower-intensity exercise, lymph flow is two to three-fold higher than when we are at rest!

Aerobic exercise such as walking, swimming, gardening, jump rope, cycling or even heavy cleaning decreases the accumulation of inflammatory cells around lymphatic structures. These movements also lead to changes in the gene expression of lymphatic endothelial cells and generally improve lymphatic function [7].

Why does exercise do such great things for our lymphatic system? While your blood has the heart to circulate it through the body, the lymphatic system relies on more subtle means of movement. Pressure changes deep within our bodies, pumping from the lymphatic vessels themselves, respiration, intestinal peristalsis (the wave-like muscle contractions that move food through our digestive tract), external compression and massage, blood vessel pulsation, and both passive and active limb movements all contribute to the movement of our lymph. Thus, the contraction and relaxation of our muscles and increased blood pulsation during movement-based activities help our lymph get where it needs to go [8].



# DEEP BREATHING

Breathing, specifically deep breathing exercise, has been researched as a beneficial therapy in groups of people with lymphedema, swelling caused by obstructions in the lymphatic system. Breathing exercises aid the flow of lymph into the chest cavity and away from sites of lymphedema, commonly the arms and legs. Think of diaphragmatic breaths as an internal massage that gently urges lymph through lymphatic vessels [9].

An easy way to remind yourself to breathe deeply is through colorful sticky note reminders placed in high-use areas of your home, such as your computer, bathroom mirror and refrigerator. Purchase three or four vibrant colors and rotate them frequently as your brain becomes accustomed to seeing the previous colorful trigger.

Another solution is to join a gentle yoga class, sometimes called yin or passive yoga. The emphasis on calm movements and focused breathing in such classes is a wonderful combination for lymphatic health.



# COMPRESSIVE GARMENTS

There's a good reason your grandmother wore compression socks! They increase both blood flow *and* lymph movement. Multiple randomized controlled trials have found substantial benefit in graduated compression garments for populations who need lymphatic support, such as people with lymphedema. Graduated compression provides greater pressure at the distal part of the body, meaning the part of the body closest to the trunk (such as the upper arm), and lessens in pressure as they descend toward the proximal end of the limb.



Thankfully, your grandma's skin-colored compression socks aren't your only style option! Socks and sleeves with modern designs are now available through multiple companies and can be discreetly worn if needed. Keep in mind that you don't have to limit the use of compression garments to illness—any situations that keep you sitting for long periods, such as car or airplane rides, board meetings or conferences are great places to use compression for lymphatic support [10].

# DRY BRUSHING

Dry brushing is the gentle brushing of completely dry skin with a dry, natural-bristle brush made from fibers such as sisal or boar bristles. Theoretically, the direction of brushing should be from the ends of the limbs towards the trunk and up to the heart. These brushing motions mimic lymphatic flow through vessels and trunks to the thoracic and right lymphatic ducts that empty the lymphatic fluid into the bloodstream. These ducts are located toward the middle of the body near the clavicle on both sides of the body.



The proposed effect of dry brushing is detoxification, gentle stimulation of the nervous system and enhanced lymphatic flow. Many people report feeling invigorated from this practice, and multiple websites recommend dry brushing to reduce cellulite and gain glowing, healthy skin.

But does dry brushing live up to the claims? The most accurate answer is... *maybe*.

While there aren't many studies on dry brushing, there is a rich ancestral history of this practice, called *garshana*, in the Ayurvedic tradition. Ayurvedic practitioners believe that *garshana* helps release toxins, improve energy, increase circulation, support cellular renewal and stimulate the lymphatic system.

With a strong history of benefits and very little chance of adverse effects, dry brushing is absolutely worth a try. The best time to dry brush, or practice *garshana*, is just before bathing. Incorporate the practice into your daily schedule for a few weeks and see if you notice a positive effect.

# GODOY AND GODOY METHOD

In 2002, two Brazilian researchers, Jose Maria Pereira de Godoy, MD, PhD, and Maria de Fátima Guerreiro Godoy, OT, PhD, published their first paper on a manual therapy aptly named the Godoy and Godoy method to support lymphatic drainage. The two scientists currently run the Godoy Clinic, where, along with their landmark hands-on approach, they also offer mechanical lymphatic drainage, compression therapy and instruction on lymphatic-focused exercises and occupational activities.

The Godoy and Godoy method consists of stimulating the lymphatic system through specific massage-like stimulation of the affected area. This form of touch is thought to affect small parts of the lymphatic system called lymphangions. The increase in lymphangion contraction created by the therapy helps the lymph move through the lymphatic system more effectively. This movement decreases the symptoms of conditions associated with an impaired lymphatic system such as cellulite, lymphedema, and even advanced diagnoses such as elephantiasis, which is caused by lymphatic filariasis, a mosquito-borne parasitic infection of roundworms.

The various research-backed methods created by the two clinicians are meant to be easily accessible to people in difficult socioeconomic positions. They offer multiple practical therapies to those who might not have access to other medical treatments for their lymphatic issues. To learn more, visit <http://en.clinicgodoy.com>.



# CASTOR OIL

While research has been done on its use as a laxative, labor inducer, pain reliever and anti-inflammatory for issues such as arthritis, no studies back castor oil as a way to support the lymphatic system. However, similar to dry brushing, the use of castor oil has a rich history of traditional use with many claims of lymphatic improvement.

Castor oil is made from the castor bean, *Ricinus communis*, a small evergreen tree that produces beautiful red blooms. Castor beans are pressed to make the thick and somewhat gummy castor oil. The oil was popularized in the modern-day alternative health movement by the mystic and healer Edgar Cayce, who recommended castor oil packs—pieces of warmed cotton or wool fully saturated with castor oil and strategically placed on the area of concern—for improvement of assimilation, elimination and circulation. He espoused the use of castor oil packs for lymphatic system health and recommended their use for everything from constipation to epilepsy.



One published case study by the Godoy clinic on the treatment of lymphorrhea, a rare but severe condition of externally draining lymph, in a young woman mentions the use of castor oil. Along with manual and mechanical lymph drainage, a special compression bandage containing zinc dioxide, glycerin, white petroleum and castor oil was applied to her legs at the lesion sites. Her healing results are stunning, and while castor oil was only one part of her protocol, its use is legitimized by some of the world's most experienced lymphatic specialists [11].

If you'd like to try using castor oil packs at home, do your best to purchase a brand that is organic and cold-pressed. You can use any clean wool or cotton fabric—simply cut the fabric into squares that fit the area of the body you'd like to apply the pack, most commonly the lower right ribcage, over the liver.

First, gently heat the fabric by laying it on a heating pad.

Then, pour castor oil into a container and thoroughly soak the fabric.

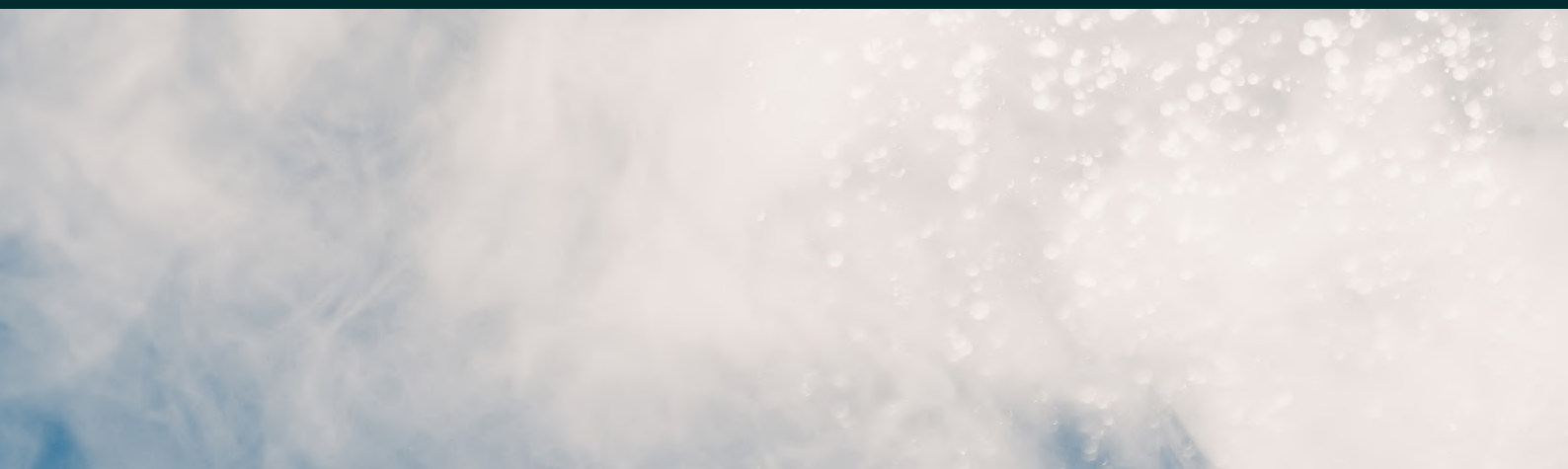
Once soaked, you'll create stacked layers, with the bottom layer being sturdy plastic, such as a garbage bag and then the pieces of oily fabric. It's easiest to lie down and securely drape the stacked layers over your body, using the plastic to protect your heating pad and any surfaces from excess castor oil. Arrange the heating pad to keep the area warm and keep the pack on for approximately an hour.



# HYDROTHERAPY

Hydrotherapy, or water therapy, is a family of traditional therapies backed by multiple current studies. Many ancient cultures used water therapies to maintain immune health and prevent disease. Cold water immersion, alternating hot and cold baths and hot water soaks top the list of hydrotherapies that are common today. Amazingly, the simple act of immersing our bodies in even room-temperature water changes our internal hydrostatic pressure, possibly leading to decreased edema and improved lymphatic function. At the same time, cold exposure increases white blood cells and other important immune-specific proteins. Hot water and exposure to heat, generally, may stimulate lymphatic contractions and increase lymph flow.

It's easy to try hydrotherapy at home, even if you don't have a bathtub! Alternating hot and cold water in the shower and warm compresses (with or without castor oil!) are two ways to use water for lymphatic support. If you have a bathtub, enjoy a long, healing soak—the addition of Epsom salts or your favorite essential oils is an optional plus [12].





# EAT HEALTHY FATS AND PROTEINS

Remember that one of the most significant roles of the lymphatic system is fat transportation. This process, combined with the immune system's deep reliance on protein for antibody (B cell) and receptor production, makes a good case for including healing fats and proteins as nutritional support for these intertwined systems.

Consider the effect of our dietary fats on the quality of lymph. As these fats are digested and assimilated into chylomicron packets in the small intestine, they are taken directly into lymphatic circulation. Trans fats or rancid fats, commonly found in processed foods or shelf-sold vegetable and seed oils, may negatively affect the form and function of chylomicrons. Interestingly, animal studies reveal that zinc deficiency may also affect chylomicron formation and transport [13].

Thankfully, eating healthy fats and proteins is a highly palatable recommendation! If we focus on pastured, ethically raised animal foods such as zinc-rich bison, venison and beef, we can fulfill our daily fat, protein and zinc requirements. Plants such as avocados, nuts, seeds and organic soy should also contribute to our fat and protein macronutrient needs.



# STAY HYDRATED

The lymphatic system is intimately linked to the amount of water in our bodies. Even the system's name reflects this connection— "lymph" is the Latin word for water. Lymph is approximately 95% water, the backdrop for all circulatory and immune functions, including those carried about by the lymphatic system. Our hydration status is vital for lymphatic health [14].



So, drink water! Unfortunately, this is not always an easy task. We live hectic lives, and access to clean water void of chlorine, fluoride or toxicants is a big problem for many populations. The Environmental Working Group's Tap Water Database is a tremendous tool for identifying both what's in your water and how to filter it, if necessary. They offer affordable filtration solutions that fit the exposures in the water where you live—all you have to do is type in your zip code.

Finally, water apps are a fantastic way to remind yourself that it's time to take a drink. There are many free apps to choose from that send you timed notifications throughout the day. If you struggle to drink enough water, these apps can be life, and lymph, changing.

# LYMPH-SUPPORTING FOODS AND HERBS

There are many medicinal foods and herbs that support the lymphatic system. However, it's critical to note that as with supplements or major dietary changes, herbs should be used with a high degree of respect. The lymphatic herb poke root, for example, that is traditionally used to help women with mastitis, can be poisonous and even deadly if used in even therapeutic amounts. So, be aware of contraindications and discuss herbal remedies with your doctor or a qualified clinician.

Burdock is a fantastic lymphatic supporting herb that doubles as a wonder food for good gut bacteria when baked or pickled. It has a somewhat opposite history of poke root, as it has been used as a toxin eliminator and remedy for those who have been poisoned. And while it is considered a potent liver purifier, it's still safe to use when pregnant [15].

Another wildly popular herb that supports the lymphatic and immune systems is turmeric. The uses of turmeric number in the hundreds! However, it's most commonly known for its digestive properties, specifically gallbladder support, as well as being anti-inflammatory and anti-cancer. But its effects on the immune system are vast. It regulates our T and B cell activities, downregulates inflammatory chemicals called cytokines, and can even enhance antibody responses when used in small doses, such as in dishes like curry. The best way to get turmeric directly into your lymphatic flow is by eating it with some healthy fats, such as coconut oil, ghee or olive oil [16].

Ginger is another culinary root that supports immune and lymphatic function. Bioactive constituents of ginger, such as gingerols and shogaols, decrease multiple inflammatory compounds and may even lead to pain-reducing effects similar to those produced by non-steroidal anti-inflammatory drugs. And it's easy to eat! Ginger can be finely grated into soups and stir-fries, chopped coarsely and boiled for ginger tea, or incorporated with your favorite frothed milk and honey for a spicy and sweet ginger and turmeric latte [17].

Gotu kola is another lymph-loving herb that may be familiar to you. It's often sold as a tincture in health food stores and is famous for treating chronic venous insufficiency, characterized by swelling, cramping and varicose veins. However, it's also indicated for stomach ulcers, psoriasis, and the lymphatic system, specifically lymphatic drainage in the lower limbs [18].

Finally, foods such as fiber-rich cruciferous greens—kale, cabbage, broccoli, Brussels sprouts and bok choy; anti-inflammatory omega-4 rich foods like salmon, flax, chia and hemp; antioxidant-rich berries; and circulation-promoting garlic are lymphatic superfoods masquerading as everyday ingredients. Do your best to incorporate these delicious and healing lymphatic system supporters into your weekly meal rotation.

**HERE'S  
TO HEALTH.**



# REFERENCES

1. Liao S, von der Weid PY. Lymphatic system: an active pathway for immune protection. *Semin Cell Dev Biol.* 2015 Feb;38:83-9. doi: 10.1016/j.semcdb.2014.11.012. Epub 2014 Dec 19. PMID: 25534659; PMCID: PMC4397130. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4397130/>
2. Dixon JB. Mechanisms of chylomicron uptake into lacteals. *Ann N Y Acad Sci.* 2010 Oct;1207 Suppl 1(Suppl 1):E52-7. doi: 10.1111/j.1749-6632.2010.05716.x. PMID: 20961306; PMCID: PMC3132563. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3132563>
3. Sandrone S, Moreno-Zambrano D, Kipnis J, et al. A (delayed) history of the brain lymphatic system. *Nat Med* 25, 538–540 (2019). <https://doi.org/10.1038/s41591-019-0417-3>. Available from: <https://www.nature.com/articles/s41591-019-0417-3?proof=t2019-11-4#citeas>
4. Dissing-Olesen L, Hong S, Stevens B. New brain lymphatic vessels drain old concepts. *EBioMedicine.* 2015 Aug 14;2(8):776-7. doi: 10.1016/j.ebiom.2015.08.019. PMID: 26425672; PMCID: PMC4563157. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4563157/>
5. Natale G, Limanaqi F, Busceti CL, Mastroiacovo F, Nicoletti F, Puglisi-Allegra S and Fornai F. Glymphatic system as a gateway to connect neurodegeneration from periphery to CNS. *Front. Neurosci.* 2021; 15:639140. doi: 10.3389/fnins.2021.639140. Available from: <https://www.frontiersin.org/articles/10.3389/fnins.2021.639140/full>
6. Jiang X, Tian W, Nicolls MR and Rockson SG. The lymphatic system in obesity, insulin resistance, and cardiovascular diseases. *Front. Physiol.* 2019; 10:1402. doi: 10.3389/fphys.2019.01402. Available from: <https://www.frontiersin.org/articles/10.3389/fphys.2019.01402/full#b71>
7. Hespe GE, Kataru RP, Savetsky IL, García Nores GD, Torrisi JS, Nitti MD, Gardenier JC, Zhou J, Yu JZ, Jones LW, Mehrara BJ. Exercise training improves obesity-related lymphatic dysfunction. *J Physiol.* 2016 Aug 1;594(15):4267-82. doi: 10.1113/JP271757. Epub 2016 Apr 9. PMID: 26931178; PMCID: PMC4967732. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4967732/>
8. Moore JE Jr, Bertram CD. Lymphatic system flows. *Annu Rev Fluid Mech.* 2018 Jan;50:459-482. doi: 10.1146/annurev-fluid-122316-045259. PMID: 29713107; PMCID: PMC5922450. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5922450/>
9. Douglass J, Mableson HE, Martindale S, Kelly-Hope LA. An enhanced self-care protocol for people affected by moderate to severe lymphedema. *Methods Protoc.* 2019 Sep 4;2(3):77. doi: 10.3390/mps2030077. PMID: 31487887; PMCID: PMC6789820. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6789820/>
10. Bundred N, Todd C, Morris J, et al. Individualising breast cancer treatment to improve survival and minimise complications in older women: a research programme including the PLACE RCT. Southampton (UK): NIHR Journals Library; 2019 Aug. (Programme Grants for Applied Research, No. 7.5.) Workstream 3: graduated compression garments to prevent onset of chronic lymphoedema. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK545402/>

11. de Godoy JM, Brigídio PA, Buzato E, Godoy Mde F. Control of lymphorrhea and treatment of warty excrescences in elephantiasis. *Case Rep Dermatol Med*. 2012;2012:834798. doi: 10.1155/2012/834798. Epub 2012 Nov 18. PMID: 23259091; PMCID: PMC3505637. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3505637/>
12. Mooventhan A, Nivethitha L. Scientific evidence-based effects of hydrotherapy on various systems of the body. *N Am J Med Sci*. 2014 May;6(5):199-209. doi: 10.4103/1947-2714.132935. PMID: 24926444; PMCID: PMC4049052. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4049052/>
13. Koo SI, Henderson DA, Algilani K, Norvell JE. Effect of marginal zinc deficiency on the morphological characteristics of intestinal nascent chylomicrons and distribution of soluble apoproteins of lymph chylomicrons. *Am J Clin Nutr*. 1985 Oct;42(4):671-80. doi: 10.1093/ajcn/42.4.671. PMID: 4050727. Available from: <https://pubmed.ncbi.nlm.nih.gov/4050727/>
14. Santambrogio L. The lymphatic fluid. *Int Rev Cell Mol Biol*. 2018;337:111-133. doi: 10.1016/bs.ircmb.2017.12.002. Epub 2018 Feb 3. PMID: 29551158. Available from: <https://pubmed.ncbi.nlm.nih.gov/29551158/>
15. Chan YS, Cheng LN, Wu JH, Chan E, Kwan YW, Lee SM, Leung GP, Yu PH, Chan SW. A review of the pharmacological effects of *Arctium lappa* (burdock). *Inflammopharmacology*. 2011 Oct;19(5):245-54. doi: 10.1007/s10787-010-0062-4. Epub 2010 Oct 28. PMID: 20981575. Available from: <https://pubmed.ncbi.nlm.nih.gov/20981575/>
16. Jagetia GC, Aggarwal BB. "Spicing up" of the immune system by curcumin. *J Clin Immunol*. 2007 Jan;27(1):19-35. doi: 10.1007/s10875-006-9066-7. Epub 2007 Jan 9. PMID: 17211725. Available from: <https://pubmed.ncbi.nlm.nih.gov/17211725/>
17. Bode AM, Dong Z. The amazing and mighty ginger. In: Benzie IFF, Wachtel-Galor S, editors. *Herbal Medicine: Biomolecular and Clinical Aspects*. 2nd edition. Boca Raton (FL): CRC Press/Taylor & Francis; 2011. Chapter 7. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK92775/>
18. Gohil KJ, Patel JA, Gajjar AK. Pharmacological review on *Centella asiatica*: a potential herbal cure-all. *Indian J Pharm Sci*. 2010 Sep;72(5):546-56. doi: 10.4103/0250-474X.78519. PMID: 21694984; PMCID: PMC3116297. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3116297/>



If you like what you've read here, be sure to [explore HealthMeans](#) for hundreds of additional health talks, eBooks and programs!

© 2022 HealthMeans. The contents of this document are for informational purposes only and are not intended to be a substitute for professional medical advice, diagnosis or treatment.

This document does not provide medical advice, diagnosis or treatment. Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition.