



# THE VAGUS NERVE AND AUTOIMMUNITY

The link between the vagus nerve and a host of inflammation issues and illness

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TIME TO READ: 12-14 MIN.

## THE TAKEAWAY

The role the vagus nerve plays in health, and improving patient vagus nerve health through laser stimulation, nutritional therapy and lifestyle.

The following excerpt is from the new best-selling book in its category:

*"Immune Reboot: Your Guide to Maximizing Immunity, Restoring Gut Health, and Optimizing Vitality."*

**YOUR VAGUS NERVE IS THE INTERFACE** that carries information to and from your gut, your microbiota, and your brain. Recent research suggests it plays a vital role in autoimmunity. If the signals up and down your vagus nerve are weak and interfere with clear communication, you want to find ways to boost it.

The vagus nerve, also known as the 10th cranial nerve, is the second-longest nerve in your body. (The longest is the sciatic nerve, which begins in the lower back and travels down the back of your leg into your foot.) The vagus arises at the back of your brain near the medulla oblongata and travels out of the skull just beneath your ear at an opening in the skull called the jugular foramen. It's the only cranial nerve to leave the skull. (In fact, like all 12 cranial nerves, your vagus nerve is paired, one on the left and one on the right. For simplicity, I refer to it in the singular.) The vagus then runs down your neck and into your chest (thorax). In the neck, branches of the vagus reach your pharynx (throat) and control your ability to swallow and your gag reflex. Further down, another branch controls your larynx (voice box). From there, the vagus branches in your trunk reach your

heart, influencing your heart rate, among other functions. Still in the chest, the vagus reaches your lungs. From there, it moves into your abdomen, where branches innervate the stomach, liver, gallbladder, pancreas, spleen, kidneys, small intestine, and the ascending and transverse sections (about half) of your colon. The vagus influences the ileocecal valve, a flap that opens to let contents from the far end of the small intestine enter the colon.

The long, meandering path the vagus nerve follows in your body is why it's often called the great wanderer. (The word vagus comes from the Latin for wandering.) The vagus nerve is a mixed nerve consisting of afferent (80% sensory, sending signals back to the central nervous system) and efferent (20% motor, sending signals to the periphery) fibers. This means it's responsible for carrying sensory information toward the central system (incoming message) and also carrying motor signals from the central nervous system toward the organs/muscle it innervates (outgoing message). The vagus nerve is proven to have a dual anti-inflammatory action via both its afferent and efferent fibers.

The vagus nerve communicates with the autonomic nervous

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system — the brain system that controls essential body functions such as heart rate and breathing. The autonomic nervous system has two parts: the sympathetic and parasympathetic nervous systems. The sympathetic nervous system responds to sudden stress; it's often called the "fight or flight" system. It makes your heartbeat faster, makes your adrenal glands release hormones such as adrenaline, makes you breathe faster, shuts down your digestive system, and generally gets you ready to respond. The parasympathetic nervous system is the opposite; it's often called the "rest and digest" or the "wine and dine" system. Among other things, it keeps your digestive system moving along smoothly. The two systems work like a seesaw. Depending on what's happening to you, one or the other predominates as needed. The vagus nerve represents the main component of the parasympathetic system, and its proper tone is critical for autonomic system balance.

The vagus nerve is in close contact with the gut and its microbiota — it can sense what's going on in the small intestine and colon, and in the metabolites the bacteria in your gut are producing. All the gut and microbiota information gets relayed along the vagus to the brain. The central autonomic network of the brain sends back responses that affect the entire digestive system.

The messages from the gut bacteria also generate a response; they respond to bacterial metabolites relayed to the vagal afferent fibers in the walls of the small intestine and colon. Chemoreceptors in the vagal afferent fibers can sense the presence of metabolites, such as butyrate, produced by gut bacteria. No matter how they reach the vagus, bacterial metabolites such as GABA, serotonin, dopamine, and acetylcholine are sent to the brain. Bacterial metabolites and cytokines can also contact the brain through blood circulation. They can pass through the blood-brain barrier and have an effect on the brain's immune cells.

Recent evidence suggests that vagal intervention in the GI tract plays a major role in controlling intestinal immune activation. Vagus nerve stimulation potentially reduces intestinal inflammation and helps restore intestinal homeostasis.

## The vagus and autoimmunity

The vagus nerve also plays a role in autoimmunity. The spleen, a lymphoid organ that is rich in white blood cells, serves as an immunological rest stop of sorts, allowing immune cells to periodically rest for a while before returning to the circulation. The vagus nerve affects the spleen through the vago-splenic pathway. The connection between the vagus nerve and the

splenic nerve occurs in the celiac ganglion. It allows the vagus and the sympathetic nervous system to act synergistically through the splenic nerve.

The splenic nerve, when stimulated, releases macrophages from the spleen back into the bloodstream. When activated, macrophages release the pro-inflammatory cytokine TNF- $\alpha$ . When vagus nerve tone is high, the neurotransmitter acetylcholine is released in the spleen. Macrophages that have been exposed to acetylcholine don't produce TNF- $\alpha$ , therefore inhibiting cytokine inflammation. Good vagal tone means the vago-splenic pathway works efficiently and decreases systemic inflammation by inhibiting the production of inflammatory cytokines from immune cells in the spleen.

Conversely, if vagal tone is low, communication through the vago-splenic pathway is also reduced, resulting in more inflammation that could be an underlying cause of autoimmune diseases such as rheumatoid arthritis and Crohn's disease. Similar interactions between sympathetic nervous system neurons appear in other places that are rich in immune cells, such as the lymph nodes, thymus, and gut.

Disruptions to the neural signaling in these body parts may also be behind some autoimmune diseases.

## 10TH CRANIAL NERVE

THE VAGUS NERVE IS ALSO KNOWN AS THE 10TH CRANIAL NERVE



## Stimulating the vagus nerve

The ability of your vagus nerve to be active and function efficiently is called vagal tone. Higher vagal tone means your body returns to normal quickly after stress. If your vagal tone is high, for example, your heartbeat returns to its normal resting rate soon after you stop exercising.

The vagal tone matters to your health. High vagal tone is associated with a lower risk of stroke and heart disease, lower blood pressure, and better digestion. Low vagal tone is associated with poorer health, including a greater risk of stroke



## As you fall asleep, your vagus nerve sends autonomic signals that increase parasympathetic activity, which helps slow your heart rate and relax you.

and heart disease, chronic fatigue syndrome, depression, and diabetes. Low vagal tone is also linked to autoimmune diseases such as inflammatory bowel disease, lupus, rheumatoid arthritis, and Hashimoto's disease.

A vital function of the vagus is to switch off inflammation. When vagal tone is low, your immune system can stay in the inflammatory mode instead of turning off and resolving the inflammation. Stimulating the vagus nerve can help restore the immune system to proper functioning. Studies have shown, for instance, that vagal stimulation can reduce the symptoms of rheumatoid arthritis by reducing the production of inflammatory cytokines. Better vagus nerve tone also decreases LPS-induced inflammation.

**12**  
THERE ARE 12 CRANIAL NERVES, ALL PAIRED, WITH ONE ON THE LEFT AND ONE ON THE RIGHT



### Laser therapy for the vagus

Stimulating the vagus nerve using non-thermal laser, also known as low-level laser therapy (LLLT), can be very helpful for quelling inflammation from autoimmunity. Laser therapy modulates the response of the innate and adaptive immune systems to pro-inflammatory mediators.

I have found that it is particularly effective for my patients with inflammatory bowel disease and those with tight junction damage. Patients who receive laser therapy show improvement in symptoms related to inflammation, such as better digestion and less joint and muscle pain. They also show consistent, repeatable improvements in heart rate variability, or HRV (a measure of the variation in time between each heartbeat). HRV is a good indicator of vagal tone and overall well-being. The greater your HRV, the better your vagal tone.

HRV is controlled by the autonomic nervous system (ANS), the part of your nervous system that works invisibly and automatically to regulate your heart rate, blood pressure, breathing, digestion, and other functions. The ANS has two components: the sympathetic and the parasympathetic system. The sympathetic system is often called the fight-or-flight mechanism; the parasympathetic system is often called the rest-and-digest response. When these two systems are out of

balance due to stress, an unhealthy diet, lack of exercise, poor sleep quality, and other stressors, your ANS can shift toward the sympathetic system at the expense of the parasympathetic system. One result of this is low vagal tone, leading to decreased heart rate variability. Stimulating the vagus nerve to improve its tone can also help restore the balance between the sympathetic and parasympathetic nervous systems and restore better heart rate variability.

LLLT works on the vagus nerve (and in the body in general) by inducing a photochemical effect that triggers biochemical changes within the cells, much as sunlight triggers photosynthesis in plants. In my practice, I use nonthermal low-level lasers at two distinctly different wavelengths. The red 635-nanometer laser light works to balance the parasympathetic nervous system. It's valuable for anti-inflammatory effects, promoting energy production at the cellular level by stimulating mitochondria and ATP production, and reducing pain.

The violet 405-nanometer wavelength stimulates the sympathetic nervous system and stimulates the immune system to help the body eliminate bacteria and viruses. Both wavelengths stimulate the vagus nerve and raise its tone by improving gut-microbiome-brain communication along the vagus.

To improve vagal tone for my patients, I use handheld lasers in both wavelengths. I apply them just above the skin to slowly track the intricate anatomy of the right vagus nerve from its origin in the medulla oblongata down through the cervical region, the trunk, and into the abdomen. I then trace the nerve back to the skull. Each pass takes about 30 seconds; I repeat the passes at least three times. Because the vagus nerve, like all cranial nerves, has both a left and right branch, I repeat the process for the left branch. To work with the body's anatomy, I also laser the lower right quadrant of the abdomen to stimulate the portion of the vagus nerve that affects the ileocecal valve and the migrating motor complex (peristalsis), applying the lasers for 45-60 seconds in the area. Next, I apply the lasers bilaterally to the transcutaneous auricular portion of the vagus nerve for 30 seconds on each site. I finish with 30 seconds of bilateral stimulation at the jugular foramen using a physiological sigh: I ask the patient to inhale quickly twice, then hold their breath for 10 seconds, and then exhale slowly. This stimulates the vagus nerve and helps shift the body toward the relaxed parasympathetic state.

### Nutritional therapy for the vagus

Foods that are rich in phytonutrients and polyphenols — in other words, whole grains, and colorful fruits and vegetables — can help raise vagal tone. (Check back to Chapter 5 for more about this.) Increasing your prebiotic fiber intake also helps by improving the gut microbiome.

Supplements of omega-3 fatty acids from fish oil are also crucial for improving vagal tone. The omega-3 in fish oil supplements is known to help improve heart rate variability and to lower blood pressure. Fish oil also inhibits the action of Toll-like receptor 4 and the NF-κB pathway. When these receptors are less sensitive, inflammation is reduced, and vagal tone improves.

Two probiotic bacteria species also positively affect the vagus nerve: *Lactobacillus rhamnosus* and *Bifidobacterium longum*. Studies have shown that *B. longum* helps reduce inflammation, stabilizes the gut lining, increases levels of BDNF in the brain, and may help reduce anxiety and depression. *L. rhamnosus* directly affects neurotransmitters in the central nervous system, increasing GABA by stimulating the vagus. Both bacteria species help improve vagal tone by improving the gut's overall health and decreasing the impact of LPS-induced inflammation.

Time-restricted eating (intermittent fasting) may also help improve vagal tone by giving your digestion rest periods throughout the day so you can get the benefit of the rest-and-digest function of the parasympathetic nervous system.

### Lifestyle for the vagus

Some self-help steps can be valuable for improving your vagal tone. The vagus is important for balancing the sympathetic and parasympathetic nervous systems and relaxing you enough to fall asleep and stay asleep.

As you fall asleep, your vagus nerve sends autonomic signals that increase parasympathetic activity, which helps slow your heart rate and relax you. Nutritional therapy for the vagus can

help you achieve a better autonomic balance and better sleep quality. Relaxation techniques before bedtime are also helpful for activating the rest response.

Cold showers or bathing/splashing the face and neck with cold water makes sympathetic activity of the vagus drop, while increasing parasympathetic activity. Singing, humming, or gargling stimulates the part of the vagus nerve that innervates the back of the throat.

As the COVID-19 pandemic has shown, autoimmunity can make you more vulnerable to serious illness. In the next chapter, I'll explain how COVID-19 affects the immune system. **CE**

[For more info go to [amazon.com](https://amazon.com) and search: *Immune Reboot* book.]

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