

Gut Health - The Connections

Ileocecal Valve, Vagus Nerve, Bacteria, Diet, and Behavior

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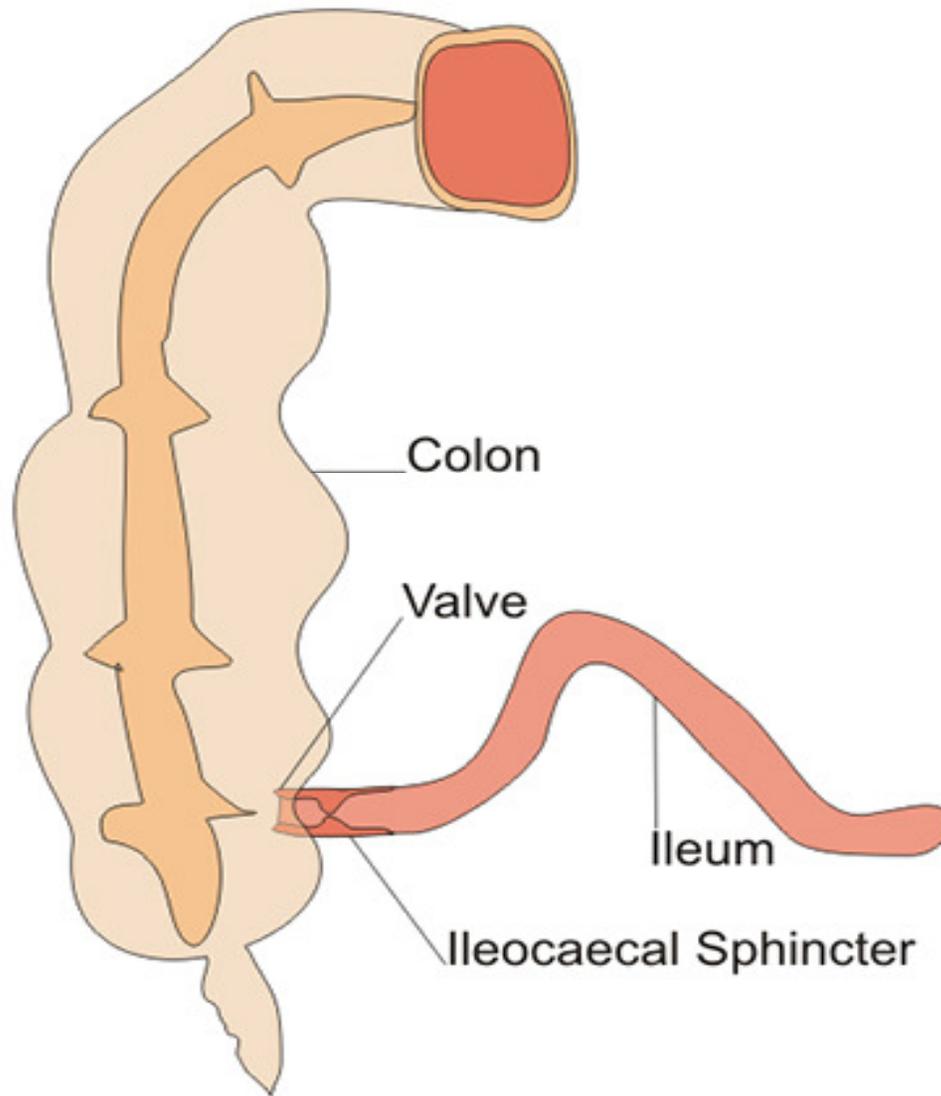
SIBO versus IBS

1. IBS (Irritable bowel syndrome) classically includes the small intestine and large intestine (colon). It causes:

- Belly cramps
- Gas
- Swelling or bloating
- Changes in your bowel habits, such as diarrhea or constipation

2. SIBO is small intestinal bacterial overgrowth. It is estimated that 80% of IBS is SIBO.

ILEOCECAL VALVE



ILEOCECAL VALVE

The structure of the **neuromuscular** components within the ICV suggests that the valve is a result of a simple intussusception (*in-folding*) of the terminal ileum (last part of *small intestine*) into the cecum.

<https://www.ncbi.nlm.nih.gov/pubmed/19089903>

(ICV is more of a part of the small intestine and not colon.)

ILEOCECAL VALVE

The ileocecal valve is the only site in the gastrointestinal tract that is used for **vitamin B12** and **bile acid absorption**.

[\[3\]](#) [\[4\]](#)

https://en.wikipedia.org/wiki/Ileocecal_valve

ILEOCECAL VALVE

- Bile is produced continuously by the liver, and stored and concentrated in the gallbladder.
- After eating, this stored bile is discharged into the duodenum.
- The duodenum is the first section of the small intestine.

<https://en.wikipedia.org/wiki/Bile> <https://en.wikipedia.org/wiki/Duodenum>

(B12 and Bile affect the ileocecal valve)

Vagus Nerve

- The vagus nerve (VN), the principal component of the parasympathetic nervous system, is a mixed nerve composed of 80% afferent and 20% efferent fibers.
- **Afferent neurons are sensory neurons** that carry nerve impulses from sensory stimuli towards the central nervous system and brain, while **efferent neurons are motor neurons** that carry neural impulses away from the central nervous system and towards the muscles to cause movement or an organ for a response.

Vagus Nerve

- The VN is able to sense the microbiota metabolites through its afferents, to transfer this gut information to the central nervous system (brain and spinal) where it is integrated in the central autonomic network, and then to generate an adapted or inappropriate response.

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

Stress inhibits the VN and has deleterious effects on the gastrointestinal tract and on the microbiota, and is involved in the pathophysiology of gastrointestinal disorders IBS and IBD, which are both characterized by a dysbiosis.

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

- A low vagal tone has been described in IBD and IBS patients thus favoring peripheral inflammation.
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Vagus Nerve

- Stress, either interoceptive or exteroceptive, is involved in the pathophysiology of IBS and IBD and can modify the gut microbiota ([O'Mahony et al., 2009](#); [Konturek et al., 2011](#); [Bonaz, 2013](#); [Barbara et al., 2014](#)).
- Stress stimulates the sympathetic nervous system while inhibiting the VN ([Porges, 1995](#); [Sahar et al., 2001](#)).
- The VN, a mixed nerve with anti-inflammatory properties both through its afferent and efferent fibers, is at the interface of the brain-gut axis ([Bonaz et al., 2016a,b](#)).
- An abnormal vagal tone is described in IBS and IBD ([Pellissier et al., 2010, 2014](#)).

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

- The communication between the brain and the microbiota is bidirectional, through multiple pathways:
 1. neural through the VN and/or spinal cord,
 2. endocrine (through the hypothalamic pituitary adrenal, HPA, axis),
 3. immune (cytokines),
 4. and metabolic [short chain fatty acids, (SCFAs), tryptophan...] ([Cryan and Dinan, 2012](#); [Brookes et al., 2013](#); [Perez-Burgos et al., 2015](#); [Forsythe et al., 2016](#); [Sarkar et al., 2016](#)).

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

- Neuroactive compounds are released by bacteria such as γ -aminobutyric acid (**GABA**), **serotonin**, **dopamine**, **acetylcholine** (ACh), and essentially act locally on the **enteric nervous system** i.e., the gut brain ([Lyte, 2011](#); [Sarkar et al., 2016](#)).
- Some of these compounds reach the big brain via blood and circumventricular organs (outside blood brain barrier) or through the VN.

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

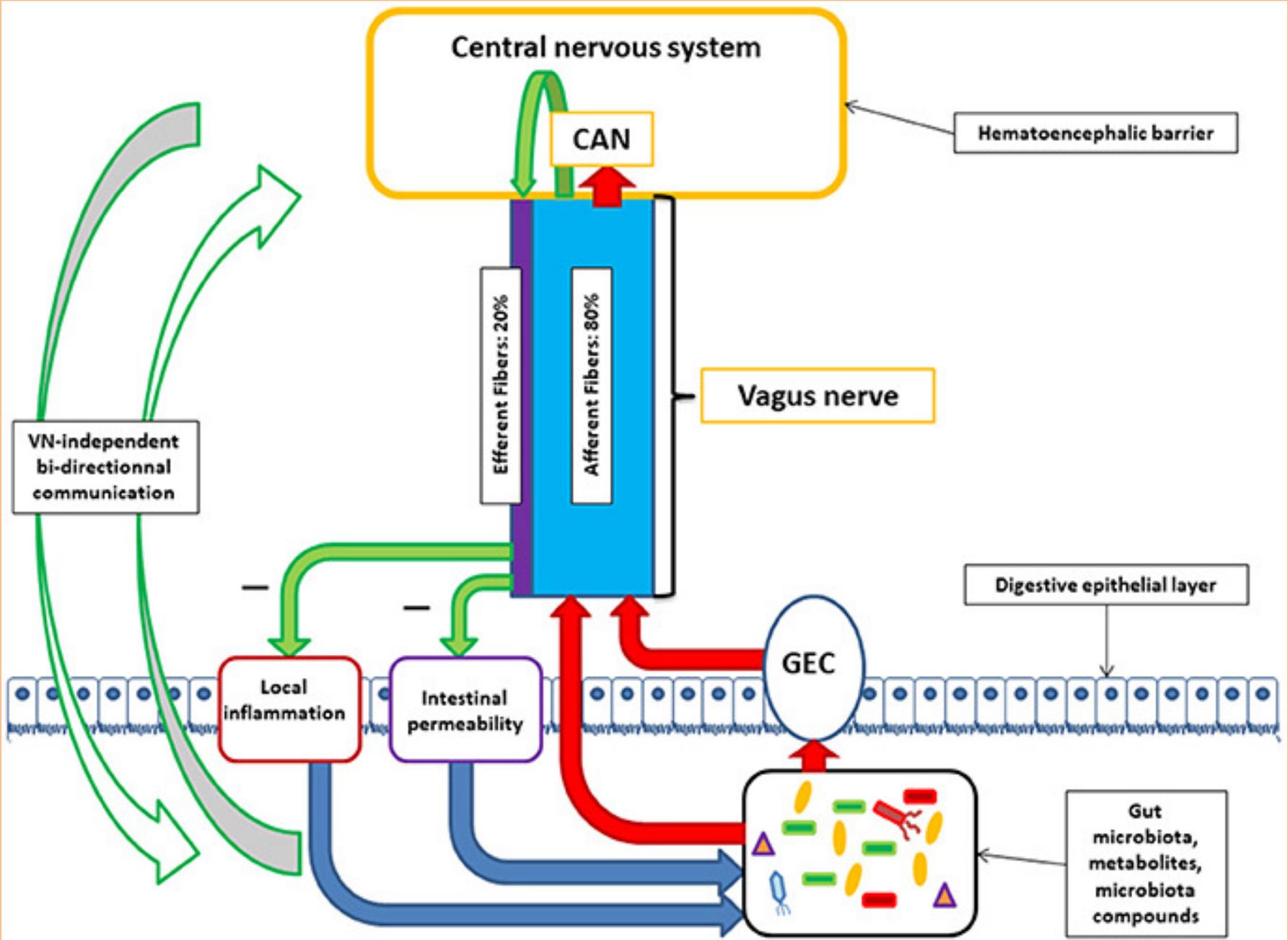


Figure 1

Figure 1.

- **Figure 1.** Communication between the central nervous system and the microbiota through the vagus nerve (VN). VN afferent fibers can be stimulated by microbiota components either directly or indirectly via gut endocrine cells (GEC).
- VN afferent fibers exert stimuli on the central nervous system via the central autonomic network (CAN).
- VN afferent fibers are able to stimulate efferent fibers through the inflammatory reflex.
- VN efferent fibers can reduce digestive inflammation and reduce intestinal permeability by tight junction reinforcement.
- These actions of vagal efferent fibers can indirectly modulate microbiota composition.
- Alongside with brain-VN-microbiota axis exists bi-directional communication by various ways.

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

- Intraduodenal injection of *Lactobacillus johnsonii* enhanced gastric VN activity ([Tanida et al., 2005](#)).
- Healthy mice chronically treated with *Lactobacillus rhamnosus* (JB-1) presented GABA brain expression modifications which increased in the cingulate cortex and decreased in the hippocampus, amygdala, and locus coeruleus.
- These animals had also reduced stress-induced corticosterone and anxiety- and depression-related behavior.
- These effects were not observed after vagotomy.
- Hence, *L. rhamnosus* have potential therapeutic indications in stress-related disorders pointing out the vagally-mediated microbiota effect on mood ([Bravo et al., 2011](#)).

<https://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full>

Vagus Nerve

- The intestinal epithelium is a barrier to prevent translocation of bacteria and other agents. Severe burn injuries in a rat scald model injuring 35% of the total body surface area result in intestinal barrier dysfunction due to gut ischemia (reduced blood flow to gut) ([Hu et al., 2013](#); [Wang et al., 2015](#)).
- VNS increases the expression and proper localization of tight junction proteins and decreases intestinal epithelial permeability ([Zhou et al., 2013](#); [Van Houten et al., 2015](#)).

[//www.frontiersin.org/articles/10.3389/fnins.2018.00049/full](http://www.frontiersin.org/articles/10.3389/fnins.2018.00049/full)

Vagus Nerve

- Vagal activity provides a protective function to the intestinal epithelial barrier and a low vagal activity makes intestinal epithelium more permeable thus promoting systemic inflammation and chronic disease.
- Stress, through its neuromediators acting on receptors located in the brain and the GI tract, increases intestinal permeability and modifies the gut microbiota ([Taché et al., 2018](#)); these two factors are involved in the pathophysiology of IBS and IBD.
- Stress inhibits the VN and stimulates the sympathetic nervous system.

VAGUS NERVE

- The vagus nerve stimulates certain muscles in the heart that help to slow heart rate.
- When it overreacts, it can cause a sudden drop in heart rate and blood pressure, resulting in fainting.
- This is known as vasovagal syncope.

The Vagus Nerve Can Overreact to Stressors

1. Exposure to extreme heat
2. Fear of bodily harm
3. The sight of blood or having blood drawn
4. Straining, including trying to having a bowel movement
5. Standing for a long time (fainting at weddings)
6. *(I expect skin damage would also have an effect as both skin and intestines have epithelial tissue)*

Things that Innervate the Vagus Nerve

1. Good bacteria
2. Good prebiotics like apples and green bananas
3. Feelings of love
4. Feelings of joy
5. Slow, deep diaphragmatic breaths
6. Meditation that reduces anxiety
7. Prayer
8. Peaceful music
9. Human connectivity and physical touch (skin)
10. Laughter
11. And managing stress to lower cortisol levels

1. THE VAGUS NERVE PREVENTS INFLAMMATION.

The vagus nerve operates a vast network of fibers around all your organs. When it gets a signal for inflammation it alerts the brain and draws out anti-inflammatory neurotransmitters that regulate the body's immune response.

2. IT HELPS YOU MAKE MEMORIES.

A University of Virginia study in rats showed that stimulating their vagus nerves strengthened their memory. The action released the neurotransmitter norepinephrine into the amygdala, which consolidated memories.

3. IT HELPS YOU BREATHE.

The neurotransmitter acetylcholine, elicited by the vagus nerve, tells your lungs to breathe. You can stimulate your vagus nerve by doing abdominal breathing or holding your breath for four to eight counts.

4. IT'S INTIMATELY INVOLVED WITH YOUR HEART.

The vagus nerve is responsible for controlling the heart rate via electrical impulses to specialized muscle tissue—the heart's natural pacemaker—in the right atrium, where acetylcholine release slows the pulse.

<http://mentalfloss.com/article/65710/9-nervy-facts-about-vagus-nerve>

5. IT INITIATES YOUR BODY'S RELAXATION RESPONSE.

When your sympathetic nervous system revs up the fight or flight responses—pouring the stress hormone cortisol and adrenaline into your body—the vagus nerve tells your body to chill out by releasing acetylcholine.

6. IT TRANSLATES BETWEEN YOUR GUT AND YOUR BRAIN.

Your gut uses the vagus nerve like a walkie-talkie to tell your brain how you're feeling via electric impulses. Your gut feelings are very real.

7. ELECTRICAL STIMULATION OF THE VAGUS NERVE REDUCES INFLAMMATION.

Stimulating (innervating) the vagus nerve can significantly reduce inflammation. Implants to stimulate the vagus nerve via electronic implants have showed a drastic reduction, and even remission, in rheumatoid arthritis.

<http://mentalfloss.com/article/65710/9-nervy-facts-about-vagus-nerve>

Gut Bacteria

1. Studies [tell us](#) that gut microbes affect the way you store fat, glucose in your blood, and how you respond to hormones that make you feel hungry or satiated.
2. Scientists have [found](#) that gut bacteria produce neurotransmitters that regulate your mood including serotonin, dopamine, and GABA.
3. Approximately 97% of Americans the recommended amount of protein. But only about 3% of Americans get the recommended 40 grams of fiber they need.
4. A 2014 study [published](#) in the journal *The Proceedings of the Nutrition Society* found that vegetables, grains, and beans fed a positive gut environment. But meat, junk food, dairy, and eggs fed a negative gut environment.

<https://foodrevolution.org/blog/best-foods-for-gut-health/>

Gut Bacteria

5. Prebiotics are found in certain fruits, vegetables, and whole grains. The most central prebiotic of all is fiber.
6. And, a 2014 study [published](#) in *Food Chemistry* found green apples boost good gut bacteria.
7. A 2013 in-vitro study [published](#) in *Food Science and Human Wellness* found that garlic boosted the creation of good gut microbes.
8. Probiotics can be helpful in treating irritable bowel syndrome, diarrhea, colitis, acne, and eczema. The strongest [evidence](#) for probiotics is related to improving gut health and boosting immune function.
9. Researchers found that probiotics had the highest rates of survival when taken within 30 minutes before or simultaneously with a meal or drink that contained some fat.

<https://foodrevolution.org/blog/best-foods-for-gut-health/>

Green Bananas

1. Multi-fibre
 - Resistant starch – improves insulin sensitivity
 - Inulin – soluble fibre good for good bacteria
 - insoluble fibre
2. Improved and more regular bowel movements
3. Resistant Starch increases metabolism, removes aflatoxins, and reduces inflammation
4. 5HTP – Increases the production of serotonin
5. Contains magnesium, potassium, zinc, and Vit. E
6. One medium green banana is low FODMAP
7. Green bananas have much less sugar than the fully ripe bananas

Microbial Endocrinology in the Microbiome-Gut-Brain Axis: How Bacterial Production and Utilization of Neurochemicals Influence Behavior

- “It is perhaps underappreciated by most microbiologists that the gut is a highly innervated organ that possesses its own nervous system known as the enteric nervous system (ENS) that is in constant communication with the central nervous system (CNS) through nerves such as the vagus, which directly connect portions of the gut to the brain.”
- “Probably one of the most dramatic examples of the interconnectedness of the gut microbiome with the host neurophysiological system is the report by Neufeld *et al.*, which demonstrated that excitability of gut sensory neurons located within the myenteric plexus of the ENS (isolated from jejunal segments of the intestine) relied on the presence of the normal commensal microbiota for proper functioning [19].”

<https://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1003726>

Organ	Positive Influence	Negative Influence
Small Intestine	Joy / Gladness	Sorrow / Sadness / Self-pity
Colon	Godliness / Honor / Respect	Shame / Dishonor / Disrespect
Stomach	Goodness / Virtue / Morality / Contentment	Greed / Disgust / Coveting / Never Satisfied / Lust
Gallbladder	Brotherly Affection / Forgiveness	Blame / Condemning / Unforgiveness
Heart	Love / Acceptance	Disdain / Rejection
Adrenals	Trust / Courage / Faith	Fear / Terror / Unrest
Ileocecal Valve	Effected by the positive and negative attributes of the small intestine, colon, and gallbladder	
Vagus Nerve	Mostly effected by the positive and negative attributes of the digestive organs, heart, and cortisol stress	

Biblical Support

- Pr 3:7 Do not be wise in your own eyes; Fear the LORD and turn away from evil. 8 It will be healing to your body and refreshment to your bones.
- Pr 12:18 There is one who speaks rashly like the thrusts of a sword, But the tongue of the wise brings healing.
- Pr 23:20 Do not be with heavy drinkers of wine, or with gluttonous eaters of meat; 21 For the heavy drinker and the glutton will come to poverty, and drowsiness will clothe one with rags.



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