

The Gut Microbiome: Empowering Your Brain Through Nutrition and Gut Health

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Agenda

- Gut microbiome basics
- Gut-brain axis pathways
- Impacts on mental health
- Ways to improve gut health
- Clinical applications
- Summary & Q&A

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Introduction

Why is this important?

- Mental Health conditions are common
- Traditional treatments don't always address the whole picture
- Microbiome provides new lens
- This understanding empowers us to provide holistic care

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What Is the Gut Microbiome?

- Bacteria, viruses, fungi and other microscopic living things are referred to as microorganisms, or microbes, for short.

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Gut Microbiome

- Most of the microbes in your intestines are found in a “pocket” of your large intestine called the cecum, and they are referred to as the gut microbiome.

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Gut Microbiome

- There are roughly 100 trillion microbes in your gut and only 30 trillion human cells. That means you are more bacteria than human.
- There are 10 times the number of bacterial cells in the human gut than in the entire human body.
- What’s more, there are up to 5,000 different species of bacteria in the human gut microbiome, and each of them plays a different role in your body. Most of them are extremely important for your health, while [others may cause disease.](#)

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Gut Microbiome...an extra organ in your body!

- Altogether, these microbes may weigh as much as 2–5 pounds (1–2 kg), which is roughly the weight of your brain. Together, they function as an extra organ in your body and play a huge role in your health.



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Core Roles of the Microbiome

- Digestion & metabolism
- Immune regulation
- Neuroactive compounds-----Neurotransmitters

Bridge to Mental Health

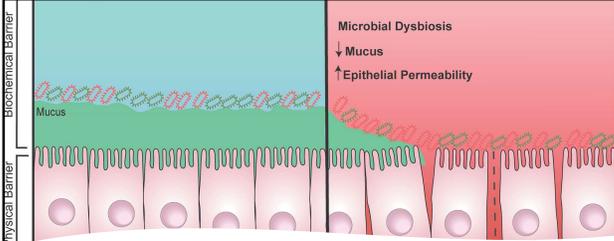


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So just like anything, it can work for us or against us...



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Dysbiosis: When Balance Breaks

- Reduced diversity
- Loss of beneficial microbes
- Overgrowth of harmful microbes
- Changes in permeability leading to inflammation
- Linked to IBS, depression, anxiety

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Inflammation leads to Depression, Anxiety and IBS

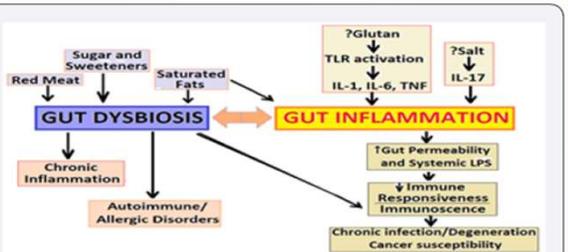


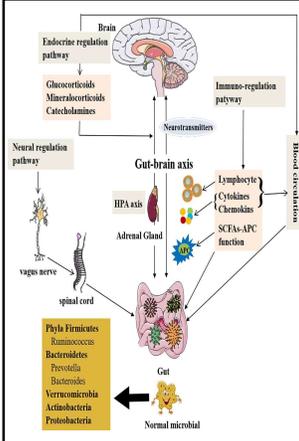
Figure 3: Genesis of Gut Dysbiosis and Chronic Gut Inflammation, and the Autoimmune, Age-related and Degenerative diseases.

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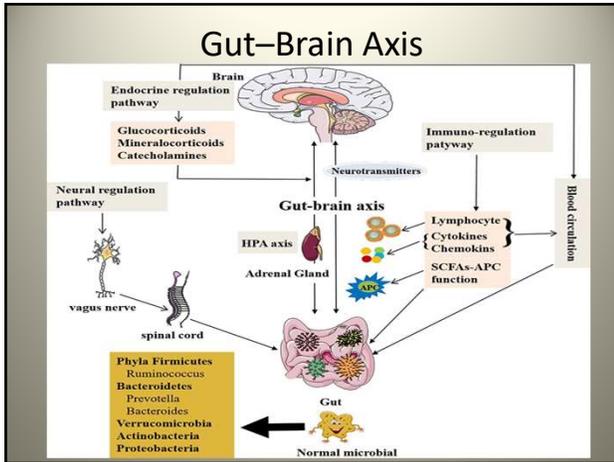
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Communication Channels

- Neural:** Vagus nerve
- Chemical:** neurotransmitters & SCFAs
- Immune/Hormonal:** cytokines and stress hormones
- Together this provides a constant feedback loop between the gut and the brain.



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Vagus Nerve: The Key Highway

- Bi-directional signaling
- Low vagal tone = high stress and inflammation
- High vagal tone = resilience
- Yoga/meditation and deep breathing raise tone...practical tools for both gut and mental health

A

B Neurological disorders associated with gut dysbiosis

Neurodegenerative disorders

- Alzheimer's disease
- Parkinson's disease
- Huntington disease
- Multiple sclerosis

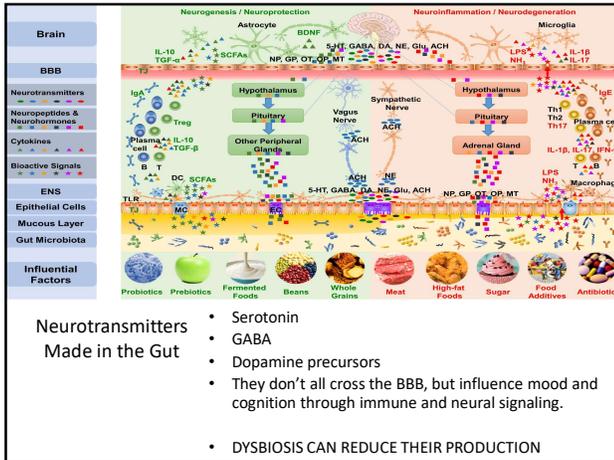
Psychiatric disorders

- Depression
- Anxiety
- Schizophrenia
- Autism spectrum disorder

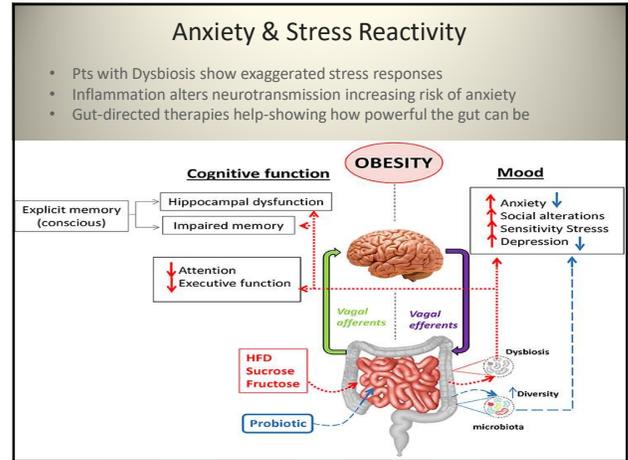
C GI symptoms involved with neurotransmitter dysfunction

- Constipation or diarrhea
- Gastrointestinal bleed
- Irritable bowel syndrome
- Inflammatory bowel disease; Crohn's disease and ulcerative colitis

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Generalized Anxiety Disorder

- Patients with generalized anxiety disorder (GAD) had lower microbial richness and diversity, as well as reduced levels of *Firmicutes* spp. and reduced microbiota that produce SCFAs, but more *Fusobacteria* and *Bacteroidete*
- Jiang H.Y., Zhang X., Yu Z.H., Zhang Z., Deng M., Zhao J.H., Ruan B. Altered gut microbiota profile in patients with generalized anxiety disorder. *J. Psychiatr. Res.* 2018;104:130-136. doi: 10.1016/j.jpsyres.2018.07.007.

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Anxiety and Ulcerative Colitis

- In addition, a prospective observational study showed that ulcerative colitis patients with anxiety exhibited a **reduction** in fecal microbiome richness and diversity, the abundances of *Prevotella_9* and *Lachnospira*, as well as immunoglobulin proteins, but had an **increase** in the abundances of *Lactobacillales*, *Sellimonas*, *Streptococcus*, and *Enterococcus*
- Yuan X.M., Chen B.Q., Duan Z.L., Xia Z.Q., Ding Y., Chen T., Liu H.Z., Wang B.S., Yang B.L., Wang X.Y., et al. Depression and anxiety in patients with active ulcerative colitis: Crosstalk of gut microbiota, metabolomics and proteomics. *Gut Microbes.* 2021;13:1987779. doi: 10.1080/19490976.2021.1987779.

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Depression and Gut Microbiota

- Studies showed that gut microbiome dysbiosis was associated with the occurrence and development of depression
- A study found obvious differences of fecal microbiota composition between healthy individuals and major depressive disorder (MDD) patients

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Depression and Microbiota

- Another study found a **relative reduction in the diversity of gut microbiota in patients with current depressive episodes**
- Additionally, a study based on a large microbiome population cohort showed that *Dialister* and *Coprococcus* spp. were decreased in patients with depression
- Furthermore, the evidence showed that MDD patients had higher levels of *Prevotella*, *Klebsiella*, *Streptococcus* and *Clostridium XI*, but lower levels of *Bacteroidetes*.
- Valles-Colomer, M.; Falony, G.; Darzi, Y.; Tigchelaar, E.F.; Wang, J.; Tito, R.Y.; Schiweck, C.; Kurilshikov, A.; Joossens, M.; Wijmenga, C.; et al. The neuroactive potential of the human gut microbiota in quality of life and depression. *Nat. Microbiol.* 2019, 4, 623–632. [CrossRef] [PubMed] 35. Lin, P.; Ding, B.; Feng, C.; Yin, S.; Zhang, T.; Qi, X.; Lv, H.; Guo, X.; Dong, K.; Zhu, Y.; et al.
- *Prevotella* and *Klebsiella* proportions in fecal microbial communities are potential characteristic parameters for patients with major depressive disorder. *J. Affect. Disord.* 2017, 207, 300–304

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The Microbiome in the Context of Depression

Depression & Mood Disorders

Research consistently shows:

- Low diversity
- Inflammation
- Diet and Probiotic/pre-biotic support effective adjuncts to standard care

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Bipolar disorder

- Bipolar disorder patients had higher abundances of *Clostridiaceae*, *Collinsella*, and the phyla of *Actinobacteria* and *Coriobacteria*, but lower abundances of *Faecalibacterium* and *Ruminococcaceae*
- Xiong, R.-G.; Li, J.; Cheng, J.; Zhou, D.-D.; Wu, S.-X.; Huang, S.-Y.; Salmaiti, A.; Yang, Z.-J.; Gan, R.-Y.; Li, H.-B. The Role of Gut Microbiota in Anxiety, Depression, and Other Mental Disorders as Well as the Protective Effects of Dietary Components. *Nutrients* 2023, 15, 3258.

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Gut Microbiota and Mental Disorders

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Cognition & Brain Fog (problems with focus, clarity memory, cloudy, mentally sluggish)

- Gut inflammation ↔ neuroinflammation
- SCFAs protect brain
- Sleep/diet help clarity

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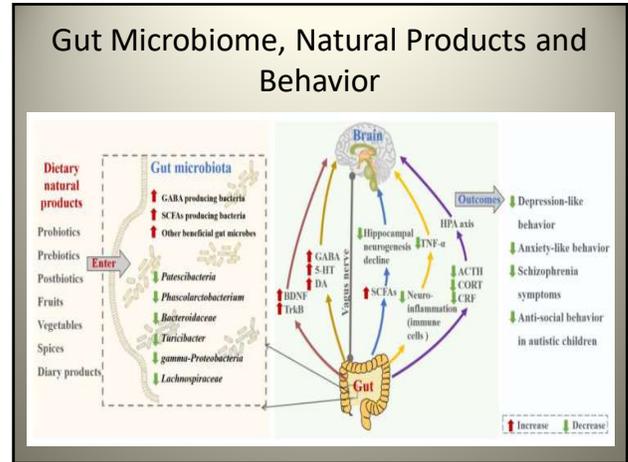
Neuroinflammation

- **Neuroinflammation ties it all together...**
- Inflammation from the gut crosses BBB causing...
- Microglial activation in the brain...
- Contributes to mood disorders and cognitive changes
- **THE HOPEFUL MESSAGE:**
- Lifestyle shifts with improved diet, sleep, stress and exercise all reduce neuroinflammation.



HEALTHY LIFESTYLE

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Case Vignette

IBS + anxiety case

Diet & probiotic added

Improved sleep, mood



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Diet Overview



- **DIET IS THE FOUNDATION OF GUT HEALTH**
- Food-first approach
- Reduce Ultra-processed foods and anything Processed, Packaged and Preserved

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Fiber-Rich Foods



- **MAIN FUEL FOR BENEFICIAL GUT MICROBES!**
- Whole grains, legumes, fruits, veg
- Prebiotic fibers (soluble fiber)
- Fermentation produces short chain fatty acids like BUTYRATE
- Reduces inflammation and supports brain health
- 25–30 g/day recommended
- Most only get half!

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Prebiotic Fiber

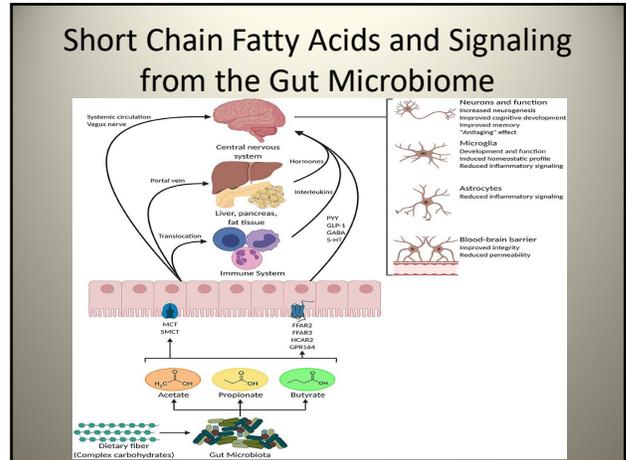
- **AKA: Soluble Fiber**
 - Food for Good Bacteria
 - Dissolve in water and other body fluids. When it does, it forms a gel-like material as it passes through. Once it makes it to the colon, it feeds your good gut bacteria.
 - Fermented by gut bacteria to produce short chain fatty acids like butyrate which nourishes cells in the colon, regulate inflammation and promote a healthy gut environment

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Insoluble Fibers

- AKA: The Digestive Sweeper
 - doesn't dissolve in fluids.
 - Instead, it absorbs fluids and sticks to other materials to form stool.
 - This process leads to softer, bulkier — and more regular — stools.
 - help food move through the digestive tract preventing constipation

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Short-Chain Fatty Acids (SCFAs) SUPPORTING THE GUT BARRIER

Fiber fermentation produces SCFAs butyrate, acetate and propionate

Support gut barrier, reduce inflammation & communicate with the brain

Low fiber = low SCFAs= MISSED OPPORTUNITY FOR BRAIN HEALTH

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Fermented Foods

- Provide live microbes
- Yogurt, kefir, kimchi, sauerkraut and miso
- Small servings daily can improve gut diversity
- Choose Low sugar choices

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Omega-3s & Polyphenols

- Fatty fish, flax, walnuts- reduce inflammation
- Berries, tea, olive oil- support microbial diversity
- Together they reduce neuroinflammation and promote resilience.

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Exercise & Microbiome

- Regular moderate exercise
- Walking 3–4x/week
- INCREASES MICROBIOME DIVERSITY
- Enjoyable, sustainable, CONTISTENT

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Sleep & Circadian Rhythm

- Poor sleep loss disrupts microbiome
- Irregular schedules or less than 7 hours per night increase inflammation and gut permeability.
- Limit late caffeine and develop a good bedtime routine with good sleep hygiene.

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Stress Management



- Stress directly impacts the gut barrier and ↑ permeability which increases inflammation and leads to dysbiosis
- Mindfulness, yoga, nature, breathing improve both gut and mental health
- 2–10 min/day can be beneficial

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HPA Axis & Stress

- **THE HPA AXIS IS OUR STRESS RESPONSE SYSTEM**
- Chronic Stress → cortisol
- ↓ diversity, ↑ permeability AND DRIVES INFLAMMATION
- Support Stress regulation is a therapy in itself

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Breathing Exercises for a Healthier Gastrointestinal Tract

Practicing breathing techniques tricks the mind into sudden relaxation, switching the parasympathetic state on and resulting in a healthier digestive system.

These are some breathing techniques you can practice for a healthier gut and microbiome. They also prevent gut inflammation, disease-causing bacteria, and the need for antibiotics with these exercises.

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Extended Exhale Breathing Exercises

Deepening your exhale is the quickest way to switch the body into relaxation mode. Follow the steps below for this technique:

- Inhale for four counts.
- Hold the inhale for two counts.
- Exhale for six counts.

If this is too difficult, simply inhale for two counts and exhale for four. Do this for as long as you'd like, but at least five minutes is recommended.

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Zen Breath

This technique is a basic breathing meditation.

Pick one of three points to put all of your focus on:

The breath coming in and out of your nostrils
Your chest rising and falling
Your belly expanding and softening

Focus on this one point for anywhere from 5-20 minutes. You can say "inhale, exhale" inside your head if it helps you focus.

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Counting

Counting your breaths is great for beginners or anyone who has trouble focusing. Practice the zen breath technique by drawing all of your attention to one point. As you inhale count "one" and as you exhale count "two." Work your way up until you get distracted and then start back over at one. Try this for 7-8 minutes and work your way up to 10-20 minutes.

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Tension Release

Here's how you can release tension and increase good bacteria in the digestive tract through breathing:

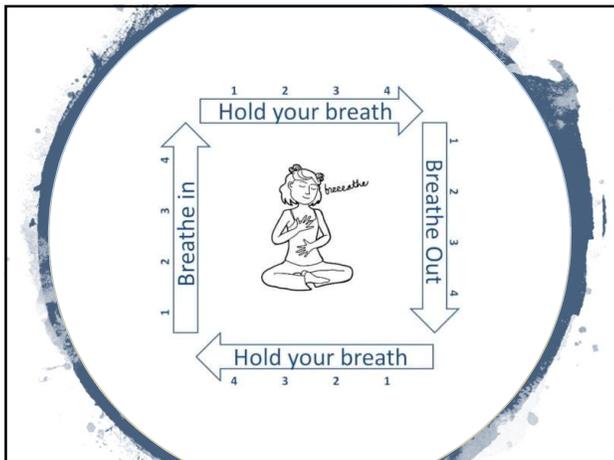
Lie down for this exercise.

Extend your arms at your side, palms facing upward. Let your breath be easy and effortless and try to relax your entire body.

Begin at your toes and work your way up to the top of your head, scanning the body for any pain or tension. Wherever you feel pain or tension, inhale deeply and exhale out the mouth.

Repeat several times before moving to the next area.

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How Can You Improve Your Gut Microbiome?

- **Eat a diverse range of foods:** This can lead to a diverse microbiome, which is an indicator of good gut health.
- In particular, legumes, beans and fruit contain lots of fiber and can promote the growth of healthy *Bifidobacteria*

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How Can You Improve Your Gut Microbiome?

- **Eat fermented foods:** Fermented foods such as yogurt, sauerkraut and kefir all contain healthy bacteria, mainly *Lactobacilli*, and can reduce the amount of disease-causing species in the gut.

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How Can You Improve Your Gut Microbiome?

- **Limit your intake of artificial sweeteners:** Some evidence has shown that artificial sweeteners like aspartame increase blood sugar by stimulating the growth of unhealthy bacteria like *Enterobacteriaceae* in the gut microbiome

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How Can You Improve Your Gut Microbiome?

- **Eat prebiotic foods:** Prebiotics are a type of fiber that stimulates the growth of healthy bacteria.
- **Prebiotic-rich foods** include artichokes, bananas, asparagus, oats and apples



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How Can You Improve Your Gut Microbiome?

- **Breastfeed for at least six months:** Breastfeeding is very important for the development of the gut microbiome. Children who are breastfed for at least six months have more beneficial *Bifidobacteria* than those who are bottle-fed



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How Can You Improve Your Gut Microbiome?

- **Eat whole grains:** Whole grains contain lots of fiber and beneficial carbs like beta-glucan, which are digested by gut bacteria to reduce weight, cancer risk, diabetes and other disorders

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How Can You Improve Your Gut Microbiome?

- **Try a plant-based diet:** Vegetarian diets may help reduce levels of disease-causing bacteria such as *E. coli*, as well as inflammation and cholesterol



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How Can You Improve Your Gut Microbiome?

- **Eat foods rich in polyphenols:** Polyphenols are plant compounds found in red wine, green tea, dark chocolate, olive oil and whole grains.
- They are broken down by the microbiome to stimulate healthy bacterial growth



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How Can You Improve Your Gut Microbiome?

- **Take a probiotic supplement:** Probiotics are live bacteria that can help restore the gut to a healthy state after dysbiosis. They do this by “reseeding” it with healthy microbes



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Brain, Behavior, and Immunity
Volume 48, August 2015, Pages 258-264

A randomized controlled trial to test the effect of multispecies probiotics on cognitive reactivity to sad mood. Laura Steenbergen a,b,f, Roberta Sellaro a,b, Saskia van Hemert c, Jos A. Bosch d, Lorenza S. Colzato

- Results: Compared to participants who received the placebo intervention, participants who received the 4-week multispecies probiotics intervention showed a significantly reduced overall cognitive reactivity to sad mood, which was largely accounted for by reduced rumination and aggressive thoughts.
- Conclusion: These results provide the first evidence that the intake of probiotics may help reduce negative thoughts associated with sad mood. Probiotics supplementation warrants further research as a potential preventive strategy for depression.

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Main Take-Aways from the study:

Multispecies **probiotic** supplementation reduced cognitive reactivity to sad mood.

- Strongest effects for reduced rumination and reduced aggressive thoughts.
- Multispecies probiotics may be used as potential preventive strategy for depression.

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Which Probiotics were used in the study?

- Multispecies probiotic containing:
- Bifidobacterium bifidum W23,
- Bifidobacterium lactis W52,
- Lactobacillus acidophilus W37,
- Lactobacillus brevis W63,
- Lactobacillus casei W56,
- Lactobacillus salivarius W24, and
- Lactococcus lactis (W19 and W58)

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British Journal of Nutrition (2011), 105, 755–764
Assessment of psychotropic-like properties of a probiotic formulation (Lactobacillus helveticus R0052 and Bifidobacterium longum R0175) in rats and human subjects
Michael Messaoudi, et al.

- Daily subchronic administration of Probiotic Formulation significantly reduced anxiety-like behaviour in rats and alleviated psychological distress in volunteers (after 30 days of tx)
- L. helveticus R0052 and B. longum R0175 taken in combination display anxiolytic-like activity in rats and beneficial psychological effects in healthy human volunteers.

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How Can You Improve Your Gut Microbiome?

- **Take antibiotics only when necessary:** Antibiotics kill many bad and good bacteria in the gut microbiome, possibly contributing to weight gain and antibiotic resistance. Thus, only take antibiotics when medically necessary.

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Effect of Antibiotics

- Antibiotic therapy alters patterns of gut microbiota and when given early in life (infancy and childhood) may shift the bacterial profile towards one that promotes obesity, metabolic abnormalities and/or autoimmune diseases.

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Antibiotics

- This relationship is seen in livestock animals given low-dose antibiotics to enhance growth and weight gain, and this relationship in humans is also being explored.

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Foods that can affect Mood



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Seafood

- When considering brain health, fish and seafood are among the most nutrient dense foods that one can eat.
- Omega-3 fatty acids are a group of essential fats that you must obtain through your diet because your body can't produce them on its own.
- Fatty fish like salmon and albacore tuna are rich in two types of omega-3s — docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) — that are linked to lower levels of depression

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The take-away...

- Fatty fish like salmon are rich in omega-3 fatty acids, which may lower your risk of depression.



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Dark Chocolate

- Chocolate is rich in many mood-boosting compounds.
- Its sugar may improve mood since it's a quick source of fuel for your brain
- Furthermore, it may release a cascade of feel-good compounds, and a substance chemically similar to cannabinoids that has been linked to improved mood
- It's also high in health-promoting flavonoids, which have been shown to increase blood flow to your brain, reduce inflammation, and [boost brain health](#), all of which may support mood regulation

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The take-away...

- Dark chocolate is rich in compounds that may increase feel-good chemicals in



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Fermented foods

- [Fermented foods](#), which include kimchi, yogurt, kefir, kombucha, and sauerkraut, may improve gut health and mood.
- The fermentation process allows live bacteria to thrive in foods and during the process, [probiotics](#) are created.
- These live microorganisms support the growth of healthy bacteria in your gut and **may increase serotonin levels which can reduce risk of depression and anxiety.**

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Serotonin

- [Serotonin](#) is a neurotransmitter that affects many facets of human behavior, such as mood, stress response, appetite, and sexual drive.
- **Up to 90% of your body's serotonin is produced by your gut microbiome.**

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The take-away...

- Since up to 90% of your body's serotonin is produced in your gut, a healthy gut may correspond to a good mood.
- Fermented foods like kimchi, yogurt, kefir, kombucha, and sauerkraut are rich in probiotics that support gut health.



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Bananas

- They're high in vitamin B6, which helps synthesize feel-good neurotransmitters like **dopamine and serotonin**
- Furthermore, one large [banana](#) (136 grams) provides 16 grams of sugar and 3.5 grams of fiber
- When paired with fiber, sugar is released slowly into your bloodstream, allowing for **stable blood sugar levels and better mood control**. Blood sugar levels that are too low may lead to irritability and mood swing

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Bananas

- When the banana is still showing green on the peel, it is an excellent source of [prebiotics](#), a type of fiber that helps feed healthy bacteria in your gut.
- A robust gut microbiome is associated with lower rates of mood disorders.



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The take-away...

- Bananas are a great source of natural sugar, vitamin B6, and prebiotic fiber, which work together to keep your blood sugar levels and mood stable.



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Oats

- Great source of fiber which helps slow your digestion of carbs, allowing for a gradual release of sugar into the bloodstream to keep your energy levels stable.
- In one study, those who ate 1.5–6 grams of fiber at breakfast reported better mood and energy levels. This was attributed to more stable blood sugar levels, which is important for controlling mood swings and irritability

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The take-away...

- Oats provide fiber that can stabilize your blood sugar levels and boost your mood.



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Berries

- Research has shown that eating more fruits and vegetables is linked to lower rates of depression
- Although the mechanism isn't clear, a diet rich in **antioxidants may help manage inflammation associated with depression and other mood disorders**
- They're particularly high in anthocyanins, a pigment that gives certain berries their [purple-blue color](#).
- One study associated a diet rich in anthocyanins with a **39% lower risk of depression symptoms**

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The take-away...

Berries are rich in disease-fighting anthocyanins, which may lower your risk of depression.



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Nuts and seeds

- Nuts and seeds are high in plant-based proteins, healthy fats, and fiber.
- Additionally, they provide **tryptophan, an amino acid responsible for producing mood-boosting serotonin**.
- Almonds, cashews, peanuts, and walnuts, as well as pumpkin, sesame, and sunflower seeds, are excellent sources

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Nuts and Seeds- Research

- A 10-year study in 15,980 people linked moderate nut intake to a **23% lower risk of depression**
- Also certain nuts and [seeds](#), such as Brazil nuts, almonds, and pine nuts, are good sources of **zinc and selenium**.
- Deficiency in these minerals, which are **important for brain function, is associated with higher rates of depression**

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The take-away...

- Certain nuts and seeds are high in tryptophan, zinc, and selenium, which may support brain function and lower your risk of depression.



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Coffee

- Increases the release of mood-boosting neurotransmitters, such as **dopamine and norepinephrine**
- A study in 72 people found that both caffeinated and **decaffeinated coffee** significantly improved mood compared with a placebo beverage, suggesting that coffee contains other compounds that influence mood-but more research is needed

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The take-away...

- Coffee provides numerous compounds, including caffeine and chlorogenic acid, that may boost your mood. Research suggests that decaf coffee may even have an effect.



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Beans and lentils

- an excellent source of **B vitamins**, which help improve mood by increasing levels of neurotransmitters like **serotonin, dopamine, norepinephrine, and gamma aminobutyric acid (GABA)**, all of which are important for regulating mood
- Furthermore, **B vitamins** play a key role in nerve signaling, which allows proper communication between nerve cells.
- Low levels of these vitamins, especially B12 and folate, have been linked to mood disorders, such as depression
- Finally, they're a good source of zinc, magnesium, selenium, and non-heme iron, which may likewise elevate your spirits

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The take-away...

- Beans and lentils are rich sources of mood-boosting nutrients, particularly B vitamins.



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Patient Assessment



NOW THAT WE KNOW ABOUT THE GUT MICROBIOME AND HOW IT IS AFFECTED BY DIET AND LIFESTYLE...



HOW CAN WE ASSESS AND ENGAGE OUR PATIENTS?

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Clinical Assessment

What does your daily diet look like?

How are your bowel habits?

How is your stress level?

How is your sleep?

Have you used any antibiotics recently?

What other medications are you on?

Readiness to change?

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Patient Education Tips

- Explain simply
- Use plain language like: "Your gut bacteria help make the chemicals that your brain needs to feel good."
- Normalize small changes and encourage gradual steps
- Handouts/portals for client communication can be helpful



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Interventions & Tools

- Start with a Four Week Plan
- Food-first
- Add a fiber source daily
- Include one fermented food
- Practice a 5-minute stress reduction technique
- Aim for consistent sleep and practice good sleep hygiene
- Plan to move at least 3 or 4 times a week
- Consume probiotics either via food or a supplement to seed the microbiome with good bacteria

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Clinical Pearls

- Start small
- Focus should be Consistency > Intensity
- Address gut health as part of a broader mental health plan, not as a replacement, but as an adjunct.

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Key Takeaways



- Microbiome and mental health are INSEPARABLE
- Diet/lifestyle = first-line...CHANGES CAN BE POWERFUL, LOW-COST AND ACCESSIBLE
- Probiotics = adjunct
- THE FOUNDATION IS HEALTHY FOOD, FIBER, FERMENTED FOODS AND HEALTHY, ACTIVE LIFESTYLE WITH STRESS REDUCTION

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