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The Second Brain: How Gut Microbiomes Contribute to Mental Health and Depression

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How Gut Microbiomes Contribute to Mental Health and Depression

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Have you ever gone with a "gut-feeling," had a "gut-wrenching" experience, or felt "butterflies" before an important interview or first date? Anyone who has can attest to how sensitive the gastrointestinal tract can be to emotion. These feelings originating from your stomach support the existence of the gut-brain axis: the communication system between your body's central and enteric nervous systems. Studies have shown that the intimate connection between a person's intestinal health and brain goes both ways. A troubled stomach sends signals to the brain the same way a troubled brain sends signals to the gut. Therefore, an unbalanced gut microbiome can affect the presence or severity of one's stress, anxiety, and depression.

The human microbiome is composed of trillions of bacteria, fungi, and other microbes. These microorganisms can be found throughout our body, but the vast majority—around 30 to 400 trillion — hang out in the gut. These microbes make chemicals that influence how your brain works. For example, some microbes create butyrate, a short-chain fatty acid essential for forming the blood-brain barrier. The brain receives information from gut microbes through millions of neurons that connect the two organs and tell the body how to behave. Sensory neurons make up the vagus nerve, which also happens to be the longest nerve of the autonomic nervous system. The vagus nerve is responsible for the bidirectional communication between the brain and gut. In a healthy state, the gut helps regulate digestion, support the immune system, and promote many other aspects of health.

For years, the bidirectional communication between the brain and gut—commonly called the gut-brain-axis—has been of significant interest. A growing body of evidence indicates that microbiota play a role in the normal regulation of behavior and brain chemistry relevant to mood and anxiety. Since the food we consume provides nutrients to support the growth and diversity of gut microbiota, diet can play a large role in gut health. In fact, studies have shown that alterations in diet can significantly influence gut bacterial composition in as little as 24 hours. In a recent experiment, ingestion of the probiotic Lactobacillus rhamnosus (JB-1) showed decreased anxiety, despair-like behavior, and stress-induced increase of plasma corticosterone levels in mice. Probiotic supplements and diet can cause this effect within the body by changing how the immune system signals the brain to alter brain function.

Gut microbiota also affect our inflammatory state by breaking down food into compounds that modify immune cells. Therefore, diet can be conceptualized as the beginning of a downstream cascade of events that can result in poor health when imbalanced. In turn, that imbalance can also affect our minds by disrupting normal brain chemistry. A set of studies that examined the relationship between chronic inflammation of the gut and behavior found that chronic stress can alter microbiota composition by causing excessive growth of pro-inflammatory bacteria and trigger inflammatory bowel disease (IBS) in both children and adults. These results further support the existence of a synergic relationship between the gut and brain.

According to the World Health Organization (WHO), depression is the leading cause of disability worldwide and contributes significantly to the global burden of disease. Yet, currently available treatments induce remission less than 50 percent of the time. A study by Jacka and colleagues investigated the efficacy of an improved diet as a treatment option for major depressive episodes. Sixty-seven participants were sorted randomly into two groups: those receiving dietary support, and those receiving social support. After three months, researchers found that although both groups experienced noticeable improvements in mood, more than 30 percent of the dietary intervention group had improved conditions compared to the 8 percent of those receiving social support. These results suggest that healthy dietary changes are possible and can help those with depression improve mental health. In a separate experiment, researchers identified three different dietary patterns and assessed their relationship with depression. They found that the group with the healthiest diet had a protective effect against depression, suggesting that a healthy diet can help treat and reduce the risk of depression.

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Although the use of probiotics and dietary intervention programs show great promise as an effective and accessible strategy in both the general population and clinical settings, we should not abandon traditional modes of treatment. Mental health is complex and often requires a variety of methods for recovery. Instead, incorporating a healthy diet into regular therapy can be more beneficial in the long run. As we gain a better understanding of the role of gut microbiota in a range of gastrointestinal and neurological disorders (including, but not limited to depression, anxiety, and stress) as well as in normal brain function, we can also explore optimal treatment options for each individual. After all, the gut microbiome functions much like a second brain!