Gut Feelings: Understanding the Connection Between Gut Health and Mental Health

by

Victoria Klausen

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APPROVED BY Capstone Advisor: Deanna C. C. Peluso, PhD, City University in Canada

Faculty Second Reader: Marie Muljiani, MC, RCC, City University in Canada

Abstract

This capstone explores the emerging connection between gut health and mental health through a review of current research on the microbiome–gut–brain axis (MGBA). While traditional counselling practices focus primarily on cognitive and emotional processes within the brain, growing evidence suggests that gut health—including microbiota diversity and integrity—may significantly influence mood, behaviour, and psychological well-being. This paper examines how factors such as diet, stress, medication use, environmental pollutants, and early life experiences impact the gut microbiome and, in turn, mental health outcomes. Framed through both solution-focused and feminist theoretical lenses, this research challenges the reductionist view of mental illness as purely brain-based and advocates for a more holistic, embodied approach to mental health care. An applied component - a psychoeducational workshop for mental health professionals - offers practice strategies to integrate MGBA-informed practices into therapeutic settings. Although limitations in the research remain, the findings underscore the potential of integrative, lifestyle-based interventions in supporting mental health and well-being.

Keywords: Microbiome-gut-brain axis (MGBA), mental health, psychobiotics, nutritional psychiatry, vague nerve, stress, diet, depression, anxiety

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Table of Contents

Chapter 1: Introduction

Overview

The field of counselling is associated primarily with the brain and how our thoughts, feelings, interpretations and experiences impact our mental health and quality of life. While this work is necessary to support the 20% of Canadians living with mental illness every year, it does not always result in symptom relief for many of the people who seek support through mental healthcare services (Follwell et al., 2021). According to Huang et al. (2016), depression is anticipated to be the leading cause of disability worldwide by 2030. Antidepressants are considered first-line treatment for those suffering from depression, however their efficacy has recently been questioned, with research calling for a reappraisal of current recommended care (Pigott et al., 2010). This paper will explore another potential pathway for addressing mental health concerns, such as anxiety and depression, by examining the interactions between the gut, its millions of microbes, and the brain. According to Rogers et al. (2016), there is a history of anecdotal reports of people experiencing psychiatric side effects from medications that directly impact the gut microbiome, such as antibiotics. My own work in mental health has made me curious about how what we eat plays a role in mental health or illness and is what drew me to wanting to research this topic further. The first chapter of this paper will outline the central research question that frames the study, while also examining the significance of this question and situating it within its broader context. Chapter 2 will provide an in-depth literature review of current research on this topic, highlighting both recent findings, as well as gaps in the literature where more research is needed. Finally, Chapter 3 will provide a discussion section, as well as an applied section that outlines an example of a workshop that could be conducted in order to disseminate this research to better help clinicians working with clients incorporate a more holistic approach to mental health care.

Research Question

As a future counsellor, I hope to assist clients by introducing them to a variety of strategies to assist them to see themselves as dynamic, connected and whole individuals, capable of navigating this ever-changing and often difficult world we live in. In order to achieve this, I believe the tools we bring to our clients need to encapsulate this multifaceted approach. We need to provide strategies that work not just on the thoughts and experiences of the brain in isolation, but on the entire system, our body as a whole, an interconnected and complex system. The aim of this research paper is to highlight the current research being done that shows how mental health and well-being is impacted not only by what is going on in our brains but also by the dynamics at play in our body, particularly within the gut and digestive system. Through the research done here, I hope to have a better understanding of the interconnectedness between the brain and the gut and how treatments that target this connection may have impacts on the mental health and well-being of individuals. I believe the research shows that the quality and quantity of our microbiota, all the microorganisms that live and work within our gut and digestive system, has an impact on the quality of our mental health (Horn et al., 2022; Clapp et al., 2017). While counsellors may not have the nutrition background to provide direct advice to clients, I believe that by having this knowledge we can better guide our clients to seek resources that may benefit them. Counselling, and medications, if necessary, are components of mental health treatment, but I do not believe they are always enough, and by looking at the body as an interconnected system, we can see how other areas may be treated in order to improve and regulate our moods, behaviours and emotions. This paper asks: How can knowledge of the microbiome-gut-brain axis (MGBA) be applied to support mental health in counselling practice?

Significance and Context of the Question

The mental health field, including counselling and psychiatry, have, focused almost exclusively on what goes on inside our brains as a way to help clients resolve difficult, and often debilitating, symptoms of mental health issues. For example, in psychotherapy, cognitive behavioural therapy (CBT) is one of the most popular therapies offered and it holds "the assumption that maladaptive cognitions are causally linked to emotional distress" (Hoffman et al., 2010, p. 2). CBT then works to change those maladaptive cognitions in the hopes that these changes will result in decreased emotional distress and maladaptive behaviours (Hoffman et al., 2010). With regards to psychiatry, treatment is inherently a medical approach, with medication being a first line treatment, and common medications for depression, such as selective serotonin reuptake inhibitors (SSRIs), have seen a fivefold increase since their introduction in the late 1980s (Kovich et al., 2023).

These examples highlight how many standard treatments for mental health concerns, such as depression, focus primarily on the brain and its perceived shortcomings. The aim of this paper is to advocate for a more holistic way of thinking about mental health treatment, one that focuses on the entire body as an interconnected system. This research is vital because despite rates of depression increasing and antidepressants being widely prescribed to adults, the consistent effectiveness of these antidepressants in treating depression is still not clearly established and reliable treatment is still lacking (Kovich et al., 2023). By isolating the brain as the sole source of our distress, we may miss looking for other ways to treat clients that may be safer and more effective.

The primary focus of this paper will be on the interconnectedness between our brain and our gut and in particular, the effect our microbiome has on our brain and its functioning in relation to mood, behaviour and overall cognition. Haripriya et al. (2024) points to the multiple ways that the gut microbiota influences brain function and behaviour regulation,

including the gut-brain axis, the immune system and neurotransmitter synthesis. However, the causal link has not yet been shown in the research and the exact mechanisms through which these changes occur is still being researched (van Zonneveld et al., 2024). Despite this uncertainty, connections between disturbances in the gut, known as dysbiosis, and mental health concerns such as stress, anxiety and depression have been observed, which has led to a shift in the way research is being done for mental disorders (Lucas, 2018). As counsellors, we often want to use techniques that are empirically tested, such as CBT, but there is also an understanding that we need to find tools that suit our clients best and that there is no one-size-fits-all approach. With this in mind, it seems reasonable that despite a lack of casual, empirical evidence to support the role of gut health in mental health, there is enough research to suggest it as a possible course of treatment for certain individuals. For clients who have an interest in mind-body connection and a willingness, or desperation, to try new treatment strategies, introducing ways to help clients navigate this new frontier of "nutritional psychiatry" may be of interest (Horn, 2022, p.10).

Conceptualization Framework

The theory of addressing mental health concerns by looking at gut health will be looked at through both a solution-focused and feminist lens. Addressing mental health concerns by looking at gut health issues will be done by looking at factors such as diet and stress and making concrete changes in these domains. Some of the guiding tenets of Solution Focused Therapy (SFT) can help provide a lens through which to look at the research in this paper. For example, de Shazer et al. (2021) discuss the tenet that "if it's not working, do something different" (p. 2). As stated above, many common treatments for depression, including medication, are not considered entirely effective or reliable across populations, and this more holistic way of looking at treatment may bring something different to clients who have tried many treatments so far and have been unsuccessful. De Shazer et al. (2021) also

point to the tenet that “small steps can lead to big changes” (p. 2). This aligns with the outlook of this paper because what some might consider trivial decisions, such as what to eat for dinner, may actually have profound impacts on one’s overall health and well-being, and that by making small changes, larger impacts may be seen.

This paper also looks at the research through a feminist lens. Researchers note that the negative changes to our gut microbiome may be due, at least in part, to modern diets and lifestyle (Pferschy-Wenzig et al., 2022). These changes, which are partly a result of the globalization of our food system, which works to make the production, marketing, and sale of our food more efficient, tend to affect those residing in poor urban areas where there are more retail venues that “facilitate the consumption of unhealthy food commodities”, such as fast-food restaurants (Logan & Jacka, 2014, p. 2). Feminist theory is rooted in the commitment to equality and an understanding of how one’s social location profoundly influences a person’s identity (Prochaska, 2013). The negative changes to our food systems, lifestyle and overall well-being can be seen as outcomes of a capitalist system in which the goal has been profit and efficiency over the health of individuals, and by starting with this knowledge and addressing concerns in a more holistic way, this research may point to ways in which we can better support clients and those we care for (Wood et al., 2023).

Relevant Areas of Literature

The research on the connection between the gut and brain, also known as the microbiome-gut-brain axis (MGBA) is something that has been contemplated historically, but is now starting to be better understood due to a renewed interest in this connection and developments in research, such as DNA sequencing and rodent studies (Shoubridge et al., 2022). The research outlined here will focus on a review of what the MGBA is, how it is thought to impact mental health, historical perspectives on the gut–brain connection, the role

of the vagus nerve, and how diet, stress, and supplements may play a role in the quality of our microbiome.

What is the Microbiome-Gut-Brain Axis?

Before looking at how the MGBA affects mental health, it's important to understand the components of the MGBA and the mechanisms through which it works. As previously mentioned, "microbiota" is a term used to describe all the microorganisms living in the human body, including bacteria and viruses, and the "microbiome" encompasses the microorganisms themselves, along with their genetic material and their interactions with their environment (Malan-Muller at al., 2018). Malan-Muller et al. (2018) point out that this communication axis, between the gut and the brain, is bi-directional, meaning that information and signals from the brain will impact the gut, just as much as information from the gut impacts the brain. They state that "stress and emotions can influence the gut microbial composition through the release of stress hormones or sympathetic neurotransmitters" which can result in physiological changes to the microbiota (p. 92). Stress is often seen as a key component of this axis, as it is demonstrated to alter intestinal permeability, which can permit bacteria to enter circulation, leading to wide ranging effects such as inflammation in the body, which is increasingly being linked to depression (Appleton, 2018). Through this research, we can see how this system is interconnected and the ways in which the brain and the gut communicate to try and create balance. Appleton (2018) notes that although research on the MGBA was introduced as early as 1910, it has taken us this long to truly start to understand the gut-brain axis as an important component in both understanding and treating depression.

Historical Knowledge

In acknowledging the historical research written about this topic, we can see that considerations about the gut-brain connection have been around for centuries in different

capacities. Phrases such as “trust your gut” or “gut instinct” that are commonly used today highlight an inherent knowledge that there is some interaction between what goes on in our gut and the way we feel and make decisions. According to Miller (2018), “ideas about the intimate relationship between gut and mind has more historical precedence than has often been realised” (p. 2). Historically, digestion was routinely linked to identity and emotional behaviour and medical communities wanted to better understand the impact of digestion on personality and moods (Miller, 2018). Miller (2018) also points out that during the nineteenth-century, the stomach was often described as “the great nervous centre” or “the great abdominal brain” due to what they observed as strong influences on the physical and emotional well-being of their patients. With such great advances in medical technology, we can now point with more certainty to how different systems of the body interact with one another, but it is important to acknowledge that these concepts are not necessarily new and that this connection has been understood, if not well explained, for many centuries (Miller, 2018).

The Vagus Nerve

In discussing the MGBA and how the brain and gut facilitate communication, one pathway that has yet to be discussed is the vagus nerve. The vagus nerve is the longest nerve in the body, connecting the Medulla Oblongata, the connection point between the brain stem and spinal cord, with the digestive tract (Bonaz et al., 2021). It contains both sensory and motor nerve fibers and innervates many organs of the body including the heart, lungs, esophagus and colon (Bonaz et al, 2021). The gut microbiota can trigger activation of the vagus nerve, which can affect communication between the brain and the CNS (Rogers et al., 2016). As previously stated, depression can be related to inflammation in the body, and vagus nerve stimulation (VNS), a treatment that has been approved for refractory depression, can help to dampen inflammation and help relieve depressive symptoms (Tan et al., 2022).

According to Bonaz et al. (2021), the "link between depression and inflammation as a vicious circle: depression promotes inflammation and vice-versa" (p. 7). Understanding the role of the vagus nerve is vital for understanding how the quality of our gut microbiome plays a role in the quality of our mental health and how we may use this understanding to develop new possible treatments, such as vagus nerve stimulation.

Lifestyle Factors

Finally, the research highlights areas where change in the everyday lifestyle of individuals may benefit their microbiota and in turn, improve their mental health. One theory looks into the use of psychobiotics, which are a class of supplements that contain both pre- and probiotics especially formulated to confer mental health benefits (Haripriva et al., 2024). While the research states that further investigations need to be done to understand the most effective strains and doses of psychobiotics, they show that administration of these supplements may play a role in regulating neurotransmitters such as serotonin and GABA, which are important for mood regulation (Haripriya et al., 2024). There are also some medicinal plants that work through similar mechanisms to benefit mental health by interacting with the gut microbiota (Pferschy-Wenzig et al., 2022). Pferschy-Wenzig et al. (2022) suggest that this is because many medicinal plants are poorly absorbed by the GI tract, making them more likely to interact with the gut microbiome and exert their effect. Finally, the research also looks at the ways in which our diet impacts our microbiota. Horn et al. (2022) state that the research at this point is not conclusive, with some studies showing no overall effect of diet on anxiety or depression, however "a growing number of interventional and mechanistic studies have confirmed a beneficial effect of a mostly plant-based diet, high in fiber and polyphenols, on mental health" (p. 2). They also point to research that shows negative effects on mental health may be particularly linked to the Standard American Diet (SAD), which has demonstrated links to an increase in markers of systemic immune

activation, which has been implicated in the pathophysiology of depression (Horn, 2022). Many pre-scientific concepts such as Traditional Chinese, Ayurvedic and Hippocratic Medicine have all understood that the body, and in particular the food we eat and our digestive system, help to modulate our mental health but in recent decades, this knowledge seems to have gotten lost (Steer, 2019). Ayurveda, a traditional Indian medical science, for example, takes a holistic approach to health by looking not just at symptoms of physical and mental health but also spiritual health, environmental considerations, dietary patterns, social welfare and seasonal variations in lifestyle (Steer, 2019). By combining this more holistic historical knowledge with what scientific research we do have, we may be able to treat mental illness in a more person-centered and thorough way through lifestyle changes.

Data Collection Procedure

The research for this paper was collected as a part of a literature review. The majority of sources were published within the last ten years, with the many being published within the last five, reflecting the most recent research on this topic. Most articles were obtained through the City University library database through keyword searches, mostly utilizing terms such as “microbiome”, “mental health”, “microbiota”, “vagus nerve” and “gut-brain axis”.

Method of Analysis

My research question states that I believe there is a connection between the quality of our microbiome and our mental health. In order to find research on this topic, I primarily used databases accessed through the CityU Library and key word searches to find articles that were published within the last five years, though some articles were included that were published up to ten years ago. In reading each article, the main findings were summarized, and key quotes were extracted to be used in the paper. As the research on this topic is not conclusive by any means, it was important to draw from articles that spoke to the complexity of the topic and did not try to push any particular agenda. Articles were then grouped based

on their utility within the paper, such as those that explain the gut-microbiome axis generally, those that looked at historical perspectives and those that spoke to different modalities for addressing microbiome concerns. Most of the articles agree that recent research does point to a connection between our microbiome and our brain health, and in particular effects on mental health. However, due to many studies varying in terms of length or treatment, conclusive and causal data is not widely available. Many articles touch on the historical context of this thinking and how the resurgence, though thought of as entirely "new" research, has been around in some capacity for hundreds of years. Overall, the general theme points to promising results while understanding there is still much that we do not know for certain.

Personal Positioning

In gaining a better understanding of the research on this topic, I am also reflecting on how my own personal experience may impact my outlook. For quite some time now I have been interested in the ways our diet and environment impact us, both mentally and physically. I have personally made changes to my diet and lifestyle and have experimented with supplements such as probiotics, as a way to improve or heal issues I have experienced. I am also skeptical of our current food systems and the ways in which companies put profit over people and promote highly processed foods, often disguised as health foods, to make money at the expense of the consumers' health. Though I still consume these processed foods, I often check labels and am wary of the ingredients found in so many common foods, such as carrageenan and silicon dioxide, that have been shown to exhibit moderate to severe impacts on the gut microbial communities of animals (Diao et al., 2021).

In terms of mental health, I have not experienced high or clinical levels of anxiety or depression. I do worry that by advocating for diet change as a solution to depression, this research could come across as minimizing the lived experience of individuals living with

these symptoms. I understand that diet and supplements will not be a "cure-all" for depression or anxiety, however I do continue to believe that changes in these domains could exert positive effects on individuals living with these mental illnesses. I also understand that access to healthy, organic food and supplements is a privilege related to socioeconomic status, and that this could work to isolate people living with little or no access to these products. Again, I hold our food systems and governments at least partially responsible for this, as I believe healthy and nutritious food should be widely available to all. I am a Caucasian, heterosexual, cis-gendered female of middle-class positioning. I acknowledge the privileges I have and that for the majority of my life and have had access to these kinds of foods. In this sense, I look at the research through a Critical Theory lens, understanding how individuals' experiences are shaped by social, political, cultural and economic structures. I also view it through a Constructivist lens and believe people's experiences and understandings of the world are based on and learned through their experiences. While the strategies suggested by the research may be beneficial for some, I also imagine suggesting such strategies could be harmful to others, and as counsellors we need to ensure we are working alongside our clients and being mindful of what strategies may be helpful or harmful.

Key Terms

- **Dysbiosis:** a state of disturbance or dysregulation of the gut microbiome (Malan-Muller et al., 2018; Lucas, 2018).
- **Enteric:** of, or related to, the intestines (Merriam-Webster).
- **Microbiome:** the complete catalogue of all the microbes living in the human body along with their genes (Malan-Muller et al., 2018).
- **Microbiome–gut–brain axis (MGBA):** a network of signals from the brain to influence the motor, sensory, and secretory functions of the gut while simultaneously

allowing signals and metabolites from the gut microbiome to influence brain development, biochemistry, function and behaviour (Pferschy-Wenzig et al., 2022).

- **Microbiota:** a term used to describe all the microorganisms (bacteria, eukaryotes, archaea, and viruses) within the human body (Malan-Muller et al., 2018).
- **Probiotics:** live, beneficial bacteria typically ingested via capsule or through fermented foods such as kimchi, yogurt or kombucha. Common probiotic bacteria's include *Lactobacillus* and *Bifidobacterium* (Haripriya et al., 2024).
- **Prebiotics:** substances that facilitate the growth of beneficial bacteria, such as non-digestible fibres and carbohydrates which can often come from fruits, vegetables, whole grains and legumes (Haripriya et al., 2024).
- **Psychobiotics:** a class of drugs that comprise both pro- and prebiotics which are specifically beneficial for mental health and whose effect on the brain is bacteria-mediated (Pferschy-Wenzig et al., 2022)
- **Vagus nerve:** it has been considered a crucial neural pathway responsible for the bidirectional communication between the gut and brain and between the gut microbiome and the brain (Pferschy-Wenzig et al., 2022). It is a mixed nerve of afferent (sensory) and efferent (motor) fibres and it is the longest nerve in the body, extending from the brain stem to the digestive tract (Bonaz et al., 2021).

Conclusion

This topic is one I find fascinating for many different reasons, and I hope that by having a better understanding of it, I will be able to utilize it, at least in part, with counselling clients in the future. While more research needs to be done to fully understand the patterns and causal effects of these types of strategies, it is clear from the research so far that there is a link between the gut and the brain and that by nurturing this relationship, we may be able to help those who are suffering with some forms of mental illness. Food is something every

person on this planet has in common and by returning to the importance of it in our daily lives, I think we can better appreciate how what we put in our bodies impacts how our bodies function. While not every mental health problem will be solved with these strategies, the research shows that for certain parts of the population, diet modification or supplementation may yield beneficial results. Though the concepts introduced in this paper, such as the link between gut health and mental health, have been part of some traditional medicine practices for centuries, it is only more recently that the research has been able to provide scientific data to back up this historical knowledge. I hope to continue to learn more as the research continues to evolve and one day be able to bring this knowledge with me into the counselling field.

The following two chapters will continue to build on this research and provide a road map for how to use this knowledge with clients. Chapter 2 provides a literature review, looking more deeply at the mind-body connection and mechanisms through which the gut and brain communicate with one another. It will also review the development of our understanding of the mind-body connection from a historical context and examine the current state of our physical and mental health care systems in Canada. This chapter will then examine a wide variety of factors that impair gut health and mental health, such as environmental pollutants, poor diet and stress, as well as strategies that can be used to improve gut health and mental health, such as quality nutrition and exercise.

Chapter 3 begins with a discussion of the literature review and ties together some of the core concepts introduced in Chapter 2. It also provides an outline of a workshop that could be used to introduce this knowledge to healthcare workers who provide services in mental health settings. I believe by providing this workshop to healthcare professionals, rather than directly to clients themselves, the information can be disseminated more widely, and can be tailored to individual client needs.

Chapter 2: Literature Review

Introduction

Getting to the root of an individual's problem when they enter counselling may depend quite heavily on the modality chosen by the therapist. For psychoanalytic therapists, conflict arises due to unconscious inner conflicts. Existential therapists may believe clients' concerns are rooted in fears of death and meaninglessness. Cognitive and behavioural therapies focus on thoughts or actions that are leading to dysfunction in the clients life and body-oriented therapies, such as somatic experiencing, focus on the psychophysiological consequences of traumatic events (Kuhfuss et al., 2021). While any one of these theories and their related treatments may help the client, it may be worth considering what could be impacting the client on a more biological level.

According to research by Dutton et al. (2018), spending on health care in Canadian provinces has steadily increased, and yet the effects of this spending on health outcomes is questionable. Of particular importance to counsellors, the rates of mental health issues such as major depression, generalized anxiety disorder and social phobias have all nearly doubled in the decade between 2012 and 2022 (Statistics Canada, 2023). Simultaneously, Statistics Canada's “Health of Canadians” report, published in 2023, showed that almost half (45.1%) of Canadians are living with a chronic illness, with the most common chronic conditions being obesity, high blood pressure, arthritis and being overweight. This paper will explore the ways in which the health of our bodies may be ultimately impacting the health of our minds, particularly by looking at the relationship between our gut, its microbiome, and our brain. This paper will aim to explore what the gut-brain axis is, the environmental factors that negatively influence the makeup of our gut microbiome and how this may negatively affect mental health, as well as ways to improve the microbiome and mental health. Finally, this

paper will discuss the challenges faced by researchers and the gaps in our knowledge and where further research is needed.

The Mind-Body Connection

While many therapeutic modalities highlight the importance of the connection between our mind and our bodies, recent medical advancements have allowed researchers to further explore the ways in which these systems interact with each other. According to Mayer (2016), the traditional view of disease was a machine model - if a part broke down, you fixed the affected part and did not need to spend time working to understand the underlying cause of why the breakdown occurred in the first place. An example highlighted in Mayer's book, "The Mind-Gut Connection", is the treatment of ulcers in the 1980's. Mayer (2016) states that at this time, when clients complained of ulcers, gastroenterologists would sometimes recommend clients undergo a vagotomy, the severing of the vagus nerve, which would decrease acid production in the stomach and alleviate pain and discomfort associated with ulcers. However, these surgeries were performed with "little consideration of the massive flow of information through the vagus nerve from the gut to the brain" (Mayer, 2016, p. 66). Clients who received this surgery often experienced relief from their ulcer symptoms, but had to endure other unpleasant gut sensations such as cramps, nausea and diarrhea, which doctors could not explain at the time. This example highlights the ways in which the medical model viewed the body as separate components that could be manipulated with little regard for the effects that may occur in the rest of the body. The following sections highlight some of the pathways by which the brain and the body, particularly the gut, communicate and connect with one another, as well as historical understandings of this connection and the ways we understand the connection between mental and physical health in Canada today.

Neurotransmitters - The Messengers

One of the ways the gut and brain communicate through is the production and absorption of neurotransmitters. One of the ways in which the microbiome may impact mental health is through the hormones and neurotransmitters that are regulated in the gut. The gut is the largest storehouse of serotonin in the body and dysregulation of the microbiome may lead to issues with the production and dissemination of this vital signalling molecule (Mayer, 2016). Serotonin is vital for many bodily functions, including intestinal functioning, "sleep, appetite, pain sensitivity, mood and overall well-being" (Mayer, 2016, p. 12). Russel et al. (2021) highlight that gut bacteria may also be capable of producing some vital neurotransmitters such as GABA and dopamine, which are key for maintaining mental health. When we think of neurotransmitters such as serotonin, we often link them directly to the brain, however it is important to understand where they are produced and how interactions with the gut microbiome may affect their production and dissemination through the body and the effect this may have on symptoms of depression or anxiety (Russell et al., 2021).

The Vagus Nerve

The primary physical mechanism of communication between the gut, its microbiome, and our brain is the vagus nerve. The vagus nerve is bidirectional, meaning information and signals flow in both top-down and bottom-up ways, and it was one of the first pathways to be discovered connecting the brain and the gut (Shoubridge et al., 2022). This allows for the gut, and the microbiome, to communicate directly with the central nervous system (CNS) through the brainstem (Rogers et al., 2016). The gut has its own nervous system, called the enteric nervous system (ENS). The ENS is embedded within the gut wall and regulates gastrointestinal functioning, nutrient absorption and immune regulation, and due to its complexity and importance, has been coined the "second brain" (Niesler et al., 2021). The

vagus nerve is the primary pathway that connects these two nervous systems and ensures the brain and the gut are able to communicate with one another.

The vagus nerve can communicate information from the gut microbiome through the ENS to the CNS, where the signal is deciphered and a response, if necessary is generated (Dalton et al., 2019). Dalton et al. (2019) state that if the signal from the ENS points to an imbalance in the gut microbiome bacteria, this could trigger an inflammatory response from the CNS, which could have wide ranging effects on the body, including symptoms of irritable bowel syndrome (IBS) and/or depression. Information transported by the vagus nerve can also stimulate the hypothalamic-pituitary-adrenal (HPA) axis, which regulates the body's response to multiple types of stressors, both physical and mental (Dalton et al., 2019). This connection is still being researched but according to Dalton et al. (2019), “HPA axis hyperresponsiveness and disturbances in the gut microbiome are found in those suffering from both IBS and psychological disorders” (p. 557). Clapp et al. (2017) also state that dysregulation of the HPA is considered one of the most reliable biological markers of major depression and anxiety. While HPA activation may occur through other mechanisms as well, it is important to understand how the gut microbiome is able to influence such a wide range of systems in the body and lead to difficulties not just with gastrointestinal symptoms, but mental health concerns as well.

The Historical Context

While the scientific research into the microbiome-gut-brain axis may appear relatively recent, we can see through historical and cultural factors that the knowledge of a profound connection between our gut and brain is not an entirely novel concept. In 1765, Scottish physician Robert Whytt introduced the idea that the stomach possessed a large amount of nerve endings and was able to send “nervous sympathy” throughout the body, connecting the body's inner organs (Miller, 2018). At this time, nerves were more of a focus than the bacteria

in the gut, but nevertheless we can see how early doctors were mindful of a connection between gut health and overall wellbeing. In the 19th-century, the stomach was regarded as a highly important organ and was given titles such as “the great abdominal brain”, as physicians took on a more holistic approach to curing diseases (Lewandowska-Pietruszka et al., 2022). During this same time period, the concept of “autointoxication” was made popular. This theory suggests that the digestive tract is inhabited by bacteria that, if not properly eliminated, could lead to “internal poisoning” and disease (Mathias, 2018). Through these examples, it is clear that physicians as far back as the 1700’s were concerned with how our gut health was connected to our overall health and how this may be impacted by both internal and external forces.

The Victorian-era of the mid-1800’s saw a surge in gastrointestinal complaints, and this was often linked to overindulgence with regards to food, alcohol and even tea (Miller, 2018). Miller (2018) notes that during this time, “doctors published a wealth of material that encouraged readers to eat moderately, digest slowly, eat at regular intervals, abstain from alcohol and consume healthy foods” (p. 4). While we are much more knowledgeable about the underlying cause of gastrointestinal concerns today than physicians of the 19th century, this advice still holds true as a base for how to maintain a healthy gut microbiome. In the 20th century, in particular following World War II, doctors were also able to identify the role of stress and poor mental health on gastrointestinal disorders, such as ulcers, and this helped to reinforce the gut-brain connection (Miller, 2018). Modern surgical procedures did lead to a period of medical reductionism, in which doctors were able to simply go in and remove internal issues, such as ulcers, eliminating the need to understand the underlying cause of the problem (Miller, 2018). Today, the medical system often still looks at symptoms in isolation and does not take the time to consider a more holistic approach, however this is starting to shift again, as more research proves the interconnectedness between body systems. This

section highlights how far we have come in terms of understanding the connection between our gut and our mind but also that these ideas are not entirely new. Even before the medical technology we have today, physicians were able to understand that what occurs in the gut affects the mind, and vice versa.

The Current State of Mental & Physical Health in Canada

In order to contextualize why counsellors and mental health professionals should better understand the mind-body connection, and in particular the role of the gut microbiome, we need to look at the current state of both mental and physical health in Canada. According to Palay et al. (2019), "mental disorders" affect around 20% of the population in Canada. Research by Statistics Canada also shows that Canadians who report their mental health as either very good or excellent has been declining in recent years. These statistics show us that Canadians are struggling with their mental health despite all the advances in medical and mental health care that have come about in the last few decades. Depression is the leading cause of disability in the world and yet current treatments are not nearly as reliable or as effective as they need to be (Morkem et al., 2015). Antidepressants are known to be a first line treatment for addressing depression and yet, according to Morkem et al. (2015), their superior effect over placebo is only present in clients with severe or recurring depression, and are therefore not recommended for those individuals who experience sub-threshold or mild depression due to "a poor risk-benefit ratio" (p. 565). These statistics highlight how difficult it has been to manage this world-wide increase in depression, and its associated increased levels of disability. The most common treatment is shown to be no more effective than a placebo when treating individuals with mild depression and yet at this point in time, no other treatments have emerged as first-line for these individuals.

At the same time, we are facing a crisis when it comes to our diet and the rise of chronic metabolic disorders such as diabetes, obesity and high blood pressure. According to

Statistics Canada's "Health Outcomes" report, the most common chronic conditions in Canada in 2021 were being overweight (35.5%), obesity (29.2%), and high blood pressure (17.7%). According to Olmo et al. (2021), this increase in chronic disease has coincided with an increase in our consumption of ultra-processed foods (UPF's) and excessive energy intake through high calorie diets. UPF's are defined as foods that are industrially processed using ingredients that would not be familiar or available to a home cook and can include things such as chips, soda, energy drinks, hot dogs, cereals, processed cheese slices, pre-made meals and mass produced bread and buns (Leung et al., 2023). UPF's have been linked to issues such as food addiction, type 2 diabetes, obesity, gut dysbiosis and inflammation (Leung et al., 2023; Sen et al., 2022). Several research studies have shown a link between inflammation, gut dysbiosis and mental health issues such as anxiety and depression (Olmo et al., 2021; Lucas, 2018; Horn et al., 2022).

Given the steady rise of both metabolic disorders, the consumption of ultra-processed foods and mental health conditions, it seems time for mental health professionals to consider more seriously the link between the mind and the body. The gut has historically been referred to as the "second brain" and while research is still working to understand the exact mechanisms of communication, it is becoming clear that what we eat, and how that affects the quality of our gut microbiome, plays a role in how we feel both physically and mentally. This research hopes to provide a path towards what Lucas (2018) refers to as "embodied mental health", in which it is recognized that improved mental health and physical health are not separate goals. The following sections will look at the ways in which our environment, diet, and stress levels all impact our gut microbiome, and in turn our mental health. It will also look at ways in which we can improve the quality of our gut microbiome and how this may lead to better outcomes for clients with depression or anxiety. Finally, it will look at

where more research is needed and how we can help our clients towards achieving a sense of wellbeing, both mentally and physically.

Factors Impairing Gut Health and Mental Well-Being

From the previous section, we get a sense of the relationship between the gut microbiome and mental health and how disruption to one system may cause disruption in the other. However, the research points to many different factors that may impact one's gut microbiome and potentially cause a disruption. According to Clapp et al. (2017), it is very difficult to establish a "normal" human gut microbiome due to the many environmental influences including diet, season, health status, and many other factors that an individual may not have complete control over. However, in this section, we will look at some of more common disruptors to one's gut microbiome including diet, stress, pollutants, medication, substance use, and even adverse childhood events.

Diet

One of the most obvious potential influences on one's gut microbiome is diet. One of the primary mechanisms through which diet affects not only the gut but the entire body is by impacting levels of inflammation in the body. When the gut is in a state of "dysbiosis" caused by an imbalance of the gut microbiome, this can lead to increased gut permeability, also known as "leaky gut", in which bacteria can enter systemic circulation, leading to an increased immune and inflammation response by the body (Clapp et al., 2017). According to van Zonneveld et al. (2024), a chronic level of low-grade inflammation in the body has been associated with the progression of several mental disorders including depression, anxiety and other mood disorders. Inflammation is a part of the body's immune response, allowing immune cells to destroy invading pathogens but a prolonged inflammatory response may lead to tissue damage and inflammatory diseases (Polokowski, 2019). Foster and Neufeld (2013) describe animal studies in which increased GI inflammation results in a notable increase in

anxiety-like behaviours, highlighting just how important it is to monitor and address intestinal and systemic inflammation in the body. A Western diet, often high in saturated fat and sugar and low in fibre, has been linked to an increase in markers of systemic immune activation, according to clinical and preclinical studies (Horn et al., 2022). The Mediterranean diet, on the other hand, which is associated with eating large amounts of fruit, vegetables, whole grains and healthy fats such as olive oil, has been linked to lower levels of inflammatory markers and an overall reduced risk for a number of chronic diseases (van Zonneveld et al., 2024). This research highlights the connection between our diet and overall health, including how the quality of our gut microbiome and the integrity of our gastrointestinal system is vital for maintaining good health, both physically and mentally.

Stress

The role of stress on the gut microbiome comes in two forms - psychological stress and oxidative stress. As discussed earlier, the gut microbiome has been shown to communicate with the hypothalamic-pituitary-adrenal (HPA) axis, which is directly related to the body's stress response (Haripriya et al., 2024). The connection between these two systems is complex and more research is needed to fully understand it but already it has been shown that psychobiotics, a term used to describe either pre- or pro- biotics that exert an effect on one’s mental health, have been shown to regulate the HPA axis (Singh et al., 2022). This pathway highlights the connection between the gut, our bodies' stress response, and the quality of our microbiome. Rogers et al. (2016) also point to research that shows how chronic stress can result in alterations of the gut microbiome and this highlights the existence of a fully bi-directional pathway between the gut and the brain. While this research is looking at the deep, physiological connection between these two systems, most people have experienced this relationship in their everyday lives. When people feel anxious, stressed or nervous, it is not uncommon to lose your appetite or feel nauseous. When we hear bad news or anticipate

the worst, we may get a feeling “in the pit of our stomachs”. Our language paints a picture of our collective understanding of how our mind and bodies are connected and how stress affects our bodies, and the research is now showing how this is happening on a more biological level.

Environmental Pollutants

Singh et al. (2022) explain the ways in which pollution in our environment may also impact our gut microbiome, ultimately affecting the gut-brain axis and our mental health. Their research highlights the fact that the progression of mental illness is rarely due to any single factor but rather is typically composed of many stressors accumulating over time including psychological, biological and environmental factors. Singh et al. (2022) state that “heavy metals, organic solvents and air pollutants are among the best-studied types of manmade and natural toxicants implicated in human psychiatric illnesses and psychological functioning” (p. 4). They point out that there are increasing amounts of research that point to heavy metals in particular as being implicated in the development and progression of both mental health and metabolic disorders. This may be due in part to direct influence of these pollutants on the brain and central nervous system but may also be related to disturbances to the gut microbiome caused by pollutants and heavy metals that we consume. Again, the understanding how these environmental factors may impact mental health highlight the multitude of pathways that connect the brain and the gut. Singh et al. (2022) state that mood disorders, which are linked to disruptions in the HPA axis, could be exacerbated by chemicals such as BPA, a common synthetic chemical often found in water bottles and food and drink packaging. As more individuals come to live in dense cities often plagued with fluctuating air quality and are reliant on purchasing food that may be coming in contact with chemicals such as BPA, it is important for research to keep working to understand how these toxins may play a role in the increased rates of mental illness and other neurological disorders.

Medication Use

The gut microbiome and pharmaceutical interventions share a complex, bidirectional relationship that can potentially impact the composition of the gut microbiome and even the effectiveness of certain drugs (Brown et al., 2023). Various medications, including antibiotics and antidepressants, can disrupt microbial diversity and overall gut health and the gut microbiota itself may play an important role in drug metabolism, potentially altering an individual's response to treatment (Brown et al., 2023). Understanding this dynamic relationship is essential for optimizing pharmacological therapies and mitigating unintended side effects. Rogers et al. (2016) point to well evidenced research that shows how even a single course of antibiotic treatment has led to significant psychiatric side effects, including increased risk for depression and anxiety. Given the complexity and the bi-directional nature of the relationship between the gut microbiome and pharmaceuticals, research may not be at a point to prove causation, however both "in vitro and in vivo studies suggests that a course of short-term antibiotics can substantially change the gut microbiota composition" (Cussotto et al., 2019, p. 1412). This research helps to paint a picture of how the microbiome and the brain are connected and in communication and how medications, such as antibiotics, may impact this system. According to Cussotto et al. (2019), antibiotics are one of the most direct and effective ways to target unwanted intestinal microbes, however we are now beginning to see how by intentionally targeting these pathogens in the gut, antibiotics may also be changing the microbiome in ways that lead to negative psychiatric symptoms for the individual.

The quality of the microbiome may also play a role in the efficacy of certain psychiatric medications, highlighting the importance of taking a holistic approach to mental health care and understanding how the gut-brain axis works (Shoubridge et al., 2022). Cussotto et al. (2021) studied the bioavailability of Olanzapine, a common antipsychotic medication used in treating bipolar disorder and schizophrenia, and found that the

microbiome may be responsible for how the drug is processed and absorbed in the gut. Brown et al. (2023) looked at this same phenomenon with regards to antidepressants and found that “there is emerging evidence to suggest that antidepressants interact with the gut microbiome to exert therapeutic effects” (p. 2). This could be an important piece to understand for mental health professionals, as there is huge variability in how individuals respond to psychiatric medications, with only around 50% of people responding positively to their first antidepressant and nearly 30% never achieving meaningful benefit, even after multiple trials (Brown et al., 2023). This could result in a huge sense of frustration for those who require pharmaceutical intervention for their depression, or other mental illness, and by understanding how the gut microbiome may play a role in this, we may be able to better support these individuals.

Substance Use

Substance use and mental health issues can often be present in the same individuals, and understanding the ways substance use may impact the microbiome may provide new information for how to treat both of these concerns. Fu et al. (2021) state that in substance-addicted individuals, the composition and diversity of the gut microbiome has been changed remarkably. The gut, sometimes referred to as the “second brain”, produces and stores over 90% of the body's serotonin and the microbiome influences this production (Horn et al., 2022). When the gut microbiome is in a state of dysbiosis, the production of critical neurotransmitters, such as serotonin, may be altered. Russell et al. (2021) highlight the fact that neurotransmitters play a critical role in the development and maintenance of addiction, and so by altering their availability, the gut may play a role in individuals substance use disorder. Alcohol use disorder (AUD), in particular, may impact the quality of the gut microbiome, as it is associated with leaky gut, which allows for bacteria to travel throughout the body, leading to increased levels of systemic inflammation, which has been noted to have

negative implications for mental health (Russell et al., 2021). A consistent pattern that emerges when looking at mental health and its connection to the gut microbiome is how bi-directional each of these systems are. Not only does a compromised gut microbiome result from problematic substance use, but it also may perpetuate addiction and make recovery more difficult.

Early Childhood Experiences

Emeran Mayer (2016) dedicates an entire chapter in his book "The Mind-Gut Connection: How the Hidden Conversation Within Our Bodies Impacts Our Mood, Our Choices and Our Overall Health" to the impacts early life experiences have on the way our gut and brain communicate. This chapter covers the ways in which our early experiences, starting in utero, affect our gut and brain development later in life. Mayer (2016) argues that if more physicians understood the connection between physical and emotional symptoms, they may be able to establish more holistic and effective treatment plans for their patients and help them to get to the root of the problem rather than simply treating what appear to be isolated symptoms. Mayer (2016) points out that changes in how the gut and brain communicate and the quality of the gut microbiome are complex and can take place at a number of life stages, including in utero, during birth and throughout childhood due to adverse or traumatic experiences. For example, during birth, the newborn is exposed to their mother's vaginal microbiota, providing them with the primary source for the colonization of their gut microbiome and the ability to digest milk and sugars (Mayer, 2016). Science is still working to understand how birth through caesarean delivery may impact this transfer of microbes and therefore the quality of the infants gut microbiome, however the research does show that babies born through C-sections are have higher rates of obesity later in life, hinting at a connection between this early microbial colonization and health later in life (Mayer, 2016). This chapter also notes that over 60% of individuals diagnosed with IBS report

experiencing a range of adverse childhood events in their early years. These stressful life events during early brain development may hardwire in heightened stress responses, leading to compromised communication between the gut and the brain. In this chapter, Mayer (2016) advocates for doctors to pay more attention to life events that may present as risk factors for a wide variety of frustrating and debilitating issues such as IBS and depression, and by doing so, potentially provide more integrative treatments that truly get to the root of the individual's problem and provide appropriate treatment.

A Path Towards Gut Health and Mental Wellbeing

Understanding the various ways in which the gut microbiome is influenced by external factors—such as diet, environmental pollutants, and daily stressors—is key to having a clear picture of all the ways our external world may impact our internal world. Disruptions to the gut microbiome may contribute to psychological distress and affect the body's ability to cope with outside stressors (Lucas, 2018). While some of these influences are impacted by factors such as geographical location, socioeconomic status, and genetic predisposition, which are often beyond individual control, research has identified modifiable factors that may enhance gut health and improve mental well-being and resilience (Horn et al., 2022; Grosicki et al., 2019). Key interventions include regular exercise, dietary modifications, and the incorporation of pre- and probiotics. The following section will examine the existing research on these factors and their role in optimizing gut-brain communication. Emerging evidence suggests that such interventions can positively influence mental health, offering potential benefits for individuals seeking support for both psychological and physiological challenges.

Exercise

Depression is one of the most common mental health concerns for which people seek counselling, and despite efforts to help alleviate symptoms for the millions of individuals who experience this debilitating illness each year, research is still looking for more effective

and well-tolerated ways to help people with this diagnosis (Brown et al., 2023). According to Yan et al. (2021), more researchers are looking into non-pharmacological treatments and state that a number of studies have shown that exercise has a significant impact on depression. As with many treatments for depression, there are several hypothesized mechanisms for understanding how exercise helps alleviate symptoms. For example, Li et al. (2024) propose that aerobic exercise increases the volume of the hippocampus in study participants, which is a key brain structure related to emotions. They propose the increase is a result of improved blood circulation that delivers the necessary oxygen and nutrients to the brain, resulting in increased hippocampal mass. Dalton et al. (2019) however, propose a different mechanism through which exercise impacts mood and well-being: by altering the gut microbiome.

Dalton et al. (2019) point to research that states that aerobic exercise promotes a more diverse gut microbiome and "may provide a link to the exercise related benefits on GI function, mood, and higher brain centers" (p. 558). While their research shows that exercise that is too vigorous or too lengthy may lead to intestinal damage, overall it shows that athletes, who regularly exercise at higher levels than the majority of the population, exhibit more diversity in their gut microbiome. It is hypothesized that these changes in the gut microbiome mediate the bidirectional relationship between the gut and the brain, which may help explain how exercise plays a role in improving mood and possibly alleviating some symptoms of depression (Dalton et al., 2019).

Unfortunately, pharmacological treatments for depression only markedly help about 50% of those who use them, and are often accompanied by a range of side effects that may make using them unsustainable in the long run (Li et al., 2024). While counselling may also be beneficial for some, this is often expensive and requires a commitment of both time and money on the part of the participant. I believe that in helping clients with depression to alleviate their symptoms, it is important to give them tools they can use on their own, for

little to no cost. This gives them access to these strategies around the clock and may provide an increased sense of self-efficacy when it comes to managing their treatment. By understanding the ways exercise may improve clients gut microbiome, thus improving communication between the gut and brain and reducing symptoms of depression, we may be able to empower clients to use this tool to help manage and hopefully alleviate symptoms of depression and other mental health struggles.

Prebiotics and Probiotics

As we explore strategies for enhancing gut microbiome health and its impact on mental well-being, it is essential to examine the role of prebiotics and probiotics. For this paper we will use the definition of each of them according to Haripriya et al. (2024) who state that probiotics are the live bacteria that are beneficial to our gut microbiome, and prebiotics are substances that facilitate the growth of the probiotics. As these bacteria and their effects on mental health have been researched, the term "psychobiotics" has emerged, which is essentially probiotics that have been shown to have a beneficial effect on mental health (Freijy et al., 2023). According to Steenbergen et al. (2015), studies done in rats have shown that administration of probiotics, in particular the bacteria Bifidobacterium infantis, led to a reduction in depressive-like symptoms similar to the effects of citalopram, a common antidepressant. While this study was done in rats, it highlights the possibility that some individuals may benefit just as much from supplementation with probiotics as from antidepressants. This is something worth considering given the variability in effectiveness of antidepressant use. Another avenue for research may be the use of probiotics as a complementary treatment for those who are on antidepressants. Brown et al. (2023) look at how the microbiome may actually exert influence on the effectiveness of antidepressants, either improving or negating their ability to work in certain individuals, which could possibly account for the variability of their effectiveness. Their research has found that antidepressants

can alter the gut microbiome in both humans and animals, however more well-controlled studies are needed to prove a clear link between these two factors. This research is particularly important because so far research has been unable to identify why some people respond well to antidepressants and others do not. While more research is still needed, it is worth considering how the foods we eat or supplements we take affect our gut microbiome and as a result, may change the way we react to certain medications.

As with much of the research surrounding the gut microbiome and mental health, there are multiple theories currently being explored to explain how probiotics may improve individuals mental health. One of the possible mechanisms, as suggested by Clapp et al. (2017), is that probiotics might be able to influence gut-brain connection and diminish the HPA axis response to chronic physiological stressors. They suggest this may be done by regulating cortisol levels and reducing inflammation. Haripriya et al. (2024) also state that psychobiotics may regulate the synthesis of neurotransmitters, such as serotonin and GABA, two neurotransmitters essential to mood regulation. As previously stated, over 90% of the body's serotonin, sometimes referred to as the “feel-good” chemical due to its influence on mood and well-being, is stored in the gut and therefore it is conceivable that the microbiome would influence its production and uptake. Prebiotics help facilitate this by providing more nutrients for the probiotic bacteria to thrive on. Freijy et al. (2023) studied whether prebiotics, probiotics or a combination could exert beneficial effects on participants' mental health. They found that a high prebiotic diet, which includes lots of fruit, vegetables and fiber, improved symptoms and severity of mood disturbances in participants. Again, questions remain as to whether this is a direct result of an increase in prebiotics, or if other factors are at play when individuals increase their fiber, fruit and vegetable intake. As more research is done, more questions arise but so far, the research points to at least some possible benefit of probiotics on

mental health, possibly by way of influencing neurotransmitter production, as well as improving communication between the gut and the brain.

Diet

A third, and possibly most intuitive way, for us to improve the integrity of our gut and the quality of our gut microbiome is through diet. According to Freijy et al. (2023), the general makeup of an individual's gut microbiome tends to remain relatively stable throughout adulthood, however dietary changes have shown to rapidly alter its composition, representing an appropriate avenue for research into ways to modulate the gut microbiome and overall gut health. The mechanisms through which diet influences gut microbiome are, again, many. This can include changes to systemic inflammation, pre- and probiotic levels, availability and uptake of certain neurotransmitters, such as serotonin, as well as many other mechanisms that are being explored (Horn et al., 2022; Freijy et al., 2023). While pre- and probiotic use has already been discussed, through this section we will discuss two other pathways by which diet may impact the gut microbiome and how those impacts may translate to changes in one’s mental health.

One of the ways researchers have seen diet affect both the gut microbiome and mental health is by impacting levels of inflammation in the body. Van Zonneveld et al. (2024) look specifically at how an anti-inflammatory diet, such as the Mediterranean diet, may benefit individuals with a diagnosis of mental illness. They state that the Mediterranean diet, which is made up largely of fruit, vegetables, whole grains and healthy fats like olive oil, has been linked to lower levels of inflammatory markers generally, as well as improved cognitive function in patients with Schizophrenia. They point to the importance of monitoring these inflammatory markers in individuals, particularly those who are predisposed to mental illness, as neuroinflammation has been increasingly recognized as a key pathological feature of neuropsychiatric disorders. Inflammation has also been linked to more common mental

health concerns, such as depression (Van Zonneveld et al., 2024). Olmo et al. (2021) state that the Western diet, which is often high in fat and sugar and low in fiber, may lead to "increased central inflammation… increased brain uptake of proinflammatory nutrients, gut dysbiosis, increased BBB (blood-brain barrier) permeability, and increased peripheral inflammation", which could contribute directly to the development of depressive symptoms (p. 10). Shoubridge et al. (2022) state that the microbiome directly influences inflammation by either increasing or decreasing the circulation of proinflammatory cells, which can be mediated by the health of the gut lining as well. These studies show us how diet can be a key trigger for inflammation throughout the body and how this chronic state of inflammation may lead to increased levels of mental illness in certain individuals.

The second mechanism to explore in relation to how diet may impact gut microbiome quality and mental health is by looking at how certain foods we eat contribute to the production and dissemination of neurotransmitters through the body. One of the more well known diet-derived substances to affect neurotransmitters is tryptophan. Shoubridge et al. (2022) state that tryptophan, which is an amino-acid derived from food, is essential for the synthesis of serotonin, in both the central nervous system and the gut. Serotonin is important for overall mood and wellbeing and for promoting pro-social behaviour, and also plays a role in the development and progression of mental illnesses such as bipolar disorder and schizophrenia (Shoubridge et al., 2022). The research by Shoubridge et al. (2022) also highlights that tryptophan availability is heavily influenced by the gut microbiome and links between the ways tryptophan is metabolised and disease progression are continuing to be looked at. Rogers et al. (2016) showed that when levels of circulating tryptophan levels were reduced, depressive symptoms reemerged in individuals who had previously seen benefit from the use of SSRIs. This highlights how important a consideration diet may be when working with individuals struggling with low mood and how dietary and lifestyle changes

may be able to work alongside pharmaceutical interventions. Tryptophan is not produced by the body and needs to be consumed through foods such as turkey, salmon, eggs, pumpkin seeds and tofu. Dysbiosis in the gut can lead to a disruption in pathways that synthesis tryptophan into serotonin, showing how the microbiome is capable of influencing both gut and brain functions (Dalton et al., 2019). While dietary changes alone are not likely to be sufficient support for those struggling with moderate to severe depression, bipolar disorder or other psychiatric concerns, it is important to understand how what we eat may impact the quality of our mental health and may empower clients to make changes where they can, in ways that can help support their journey towards improved mental health.

Conclusion

This chapter has explored the growing body of research on the gut microbiome and its influence on mental health through physiological, environmental, and lifestyle factors.. There has been a steady increase in the prevalence of both mental health and metabolic concerns in the last two decades, and this research points to a possible link between the two, helping us better understand how what goes on in our gut may actually be impacting what goes on in our brains. While the understanding that there is a connection between our gut and our brains isn't inherently new knowledge, as scientists from as far back as 1765 believed this connection existed, our ability to examine what's going on inside the body and trace the impact on these connections has been made possible to scientific advancements and a renewed desire to understand the mind-body connection (Miller, 2018). This chapter highlights the many ways in which our environment, diet, stress levels and even early childhood experiences may impair the quality of our gut microbiome and overall gut health. When these imbalances are communicated to the brain via the vagus nerve, this can lead to a wider response within the body, one that may lead to symptoms of depression or anxiety in certain individuals. This knowledge may provide clients with a new tool to help them

understand the root cause of their mental health issues, as well as strategies to help them repair their gut microbiome and possibly alleviate some of their mental health concerns.

While clients may not be able to change all the environmental factors that could be negatively affecting their mental health, the research outlined in this chapter highlights how diet, supplementation with pre- and probiotics and exercise have shown to improve gut microbiome health and in turn, improve the client's mental health. While not all mental health concerns may be addressed using these strategies, providing clients with the insight into how their mind and body are connected may empower them to take control of both their physical and mental health in a new way. Chapter 3 will build on these findings by exploring how this knowledge can be applied in counselling settings and outlining a practical intervention for mental health professionals.

Chapter 3: Discussion and Applied Practices

Following the above literature review, this third and final chapter will discuss the findings from the research and how they relate to the research question posed in chapter one. This question focused on understanding the complex relationship between the gut and the brain and how the quality of the gut microbiome impacts mental health. In reflecting on the research found, this chapter will aim to highlight ways in which the current research supports the importance of understanding the gut-brain connection while also discussing limitations and gaps in the research. This chapter will also provide a proposal for a way in which to apply this research by way of a psychoeducation group designed for therapists, social workers or nurses in the community mental health setting who may wish to incorporate holistic knowledge of the gut-brain connection into their work. The aim of this proposal is to bring the research from the academic into the applied field in the hopes of benefiting clients by supporting their mental health in a way that supports the whole person and treats mental health as a part of overall health and wellbeing.

Discussion

In order to better position the findings from the literature review from Chapter two, we will first revisit the research question and its context and significance as outlined in Chapter one. The research question aims to understand how knowledge of the gut-brain axis and its effects on mental health may inform a more holistic approach to mental health care, in which both the psychological and physiological factors are attended to. The importance of this question comes at a time when mental health care is heavily focused on cognitive treatments, like cognitive behavioural therapy (CBT), alongside an increase in prescription medication use for mental health concerns (Morkem et al., 2015). While both of these treatment modalities are helpful for a large number of individuals, it may not be adequate to support all clients who seek help dealing with mental health concerns, such as depression or

anxiety. The importance of this is made clear when, despite our best efforts, we continue to see cases of mental illness rising, especially among young people, among whom mental illness is the leading cause of disability (Chiu et al., 2020). One of the factors many mental health professionals may fail to address is the role of the gut-brain axis and how disruptions to this communication system may lead to symptoms of anxiety or depression in some individuals (Lucas, 2018). This topic, like many related to mental health, is complex, but this chapter will aim to highlight some of the key takeaways from the research that shows just how important the gut-brain connection is to overall mental health and well-being.

Bidirectional Communication

The first key takeaway the research highlights is that the gut-brain connection is a bidirectional communication channel, in which both the gut and the brain provide and react to information in the system. As stated by Shoubridge et al. (2022), one of the first pathways to be discovered linking the gut and the brain was the vagus nerve. As discussed earlier, the vagus nerve is the longest nerve in the body and information is transported between the gut and certain areas of the brain, such as the hypothalamus and hippocampus, which are involved in the regulation of emotions and the body's stress response (Dalton et al., 2019). One example of bottom-up communication, in which what goes on in the gut influences activity in the brain, is the production of serotonin. 95% of serotonin is created and stored in cells within the gut and gut lining, and its production and secretion is directly influenced by the foods we eat and the quality and quantity of our gut microbiome (Horn et al., 2022). Disruptions in the gut, whether from poor diet, stress or substance intake, may lead to decreases in serotonin production, leading to issues with mood, sleep and cognitive functioning (Haripriya et al., 2024). To highlight a top-down example that also focuses on serotonin, research has shown that SSRI’s, which target serotonin levels in the brain, have been shown to help alleviate symptoms of GI distress in some patients (Dalton et al., 2019).

These examples provide evidence that the brain and gut are in direct communication with one another, and that disturbances in one can lead to negative effects in the other. With this knowledge as a base, we can move onto other findings from the research that highlight what internal and external factors may impact the quality of our gut and microbiome and how those impacts may show up in the brain.

Multiple Factors Disrupt Gut Microbiome Health

Another key takeaway from the research is that there are many environmental factors that can lead to disruption in the gut microbiome. As noted in Chapter two, establishing a "normal" gut microbiome is very difficult because the makeup of an individual's microbiome can vary widely based on location, diet, and health status (Clapp et al., 2017). However there are some environmental factors that have been proven to interfere with a healthy gut microbiome more than others and lead to negative outcomes for one's mental and physical health. One of the most intuitive disruptors to gut and microbiome health is diet. The modern food system and Canadian diet are increasingly made up of ultra-processed foods, which are typically ready-to-eat, low in nutrients, fibre and protein and high in salt, fat and sugar (Sen et al., 2022). Research by Sen et al. (2019) states that recent research coming out of high-income countries, such as Canada, shows that ultra-processed foods account for 50-60% of total daily caloric intake. On the other hand, Horn et al. (2022) highlight evidence of a statistically significant relationship between higher intake of fruits, vegetables, fish and whole grains (i.e. foods that are not ultra-processed) and better mental health, measured by lower levels of depression. This shows that while our consumption habits are shifting towards the ease and convenience of ultra-processed foods, there are clear mental and physical health benefits to eating whole foods and when addressing depression in clients, diet should be one of the factors assessed for.

Stress is another lifestyle factor that can lead to disruptions in gut health. While stress is already understood to negatively impact mental health, this relationship between the gut and brain highlights how widespread the effects of stress can be on the body, as well as tools we can use to possibly mitigate further problems by addressing the effects of stress on gut health (Rogers et al., 2016). While this relationship is complex, one of the tools highlighted repeatedly in the literature is the use of pre- and probiotics to reduce symptoms of stress related diseases, including effects on mental health. According to Clapp et al. (2017), "probiotics have the potential to diminish the HPA axis response to chronic stressors, and prevent or reverse physiologic damage" (p. 134). This provides an example of how supporting the gut microbiome through supplementation of probiotics can decrease the experience of stress in the body, likely leading to reduced mental health effects from stress.

Other external factors that can lead to an imbalance in the gut microbiome include environmental pollutants, medications, substance use, and even adverse early childhood experiences (Singh et al., 2022; Rogers et al., 2016; Fu et al., 2021; Mayer, 2016). Understanding the ways in which our environment may be impacting our gut health, and therefore our mental health, allows us to take a more holistic approach to mental health care. However, what also must be considered is how these factors may impact certain individuals more than others. For example, individuals with lower socio-economic status (SES) may be forced to live in areas that experience higher levels of ambient pollution, such as near factories or along heavily polluted roadways (Flanagan et al., 2019). While we can be aware of the implications of pollution on mental health, for some individuals it may not be possible to limit their exposure if they are unable to afford housing in neighbourhoods less affected by pollution.

Socio-economic factors may also need to be considered when it comes to the effects of a diet high in ultra-processed foods. While health care professionals may recommend an

individual lower their intake of these types of foods in order to improve their gut and mental health, we need to be mindful of socioeconomic factors that may make purchasing and preparing whole foods more difficult for some people. Research by Miller et al. (2016) looked at overall microbiota diversity in relation to socioeconomic status and found that individuals living in neighbourhoods with lower SES had less microbiota diversity than those living in high SES neighbourhoods. This research was undertaken to try and better understand the health disparity seen across different income groups and this decrease in microbiome diversity may account for some of the worse health outcomes seen in lower SES communities. While it is important to assess how different environmental factors may compromise gut health and thus impact mental health, it is also vital to understand that not everyone is affected by these factors equally and that recommendations need to be tailored to assess the resources of each client.

Gut Health Influences Treatment Effectiveness

The third key indication from the literature review is that not only does gut health directly impact mental health, it also impacts treatment. As stated in Chapter one, antidepressants are often a first-line treatment for clients experiencing depressive symptoms, however their effectiveness is mixed at best (Morkem et al, 2015). Cussotto et al. (2019) discuss the growing evidence to support the interaction between the gut microbiome and certain psychotropic medications, which may mean the gut microbiome may be one avenue to explore when it comes to why some people respond positively to these medications while others do not. Though counsellors are not prescribing medications to clients, we may work with many clients who are on medications such as antidepressants, and it would be beneficial to understand this gut-brain interaction and be able to help clients navigate both the risks and benefits of these medications.

Brown et al. (2023) point out that, again, this relationship is bidirectional and that antidepressants have also been shown to have an effect on the makeup of the gut microbiome. This can make it difficult to determine causation and therefore this is an area where more research is needed. There are many variables that impact a client's response to antidepressants, including family history, genetics, age of onset, substance use and other lifestyle factors (Brown et al., 2023). Pharmacomicrobiomics (PMx), which is the study of how the gut may potentiate or hinder the effects of certain medications, is an area of research that is relatively new and more well-controlled studies are needed in order to truly understand cause and effect (Brown et al., 2023). This is important to keep in mind, as new understandings of these gut-brain dynamics are exciting and potentially beneficial to clients, it is not a cure-all and counsellors need to be mindful of this when providing suggestions for clients.

Lifestyle Interventions Can Improve Both Gut and Mental Health

The final key outcome from the literature review is that there are lifestyle changes that can be made that research has shown can improve both gut health and mental health. Exercise, for example, has recently been shown to increase diversity in the gut microbiome, which is important because microbiota richness and diversity have been associated with remission from depression (Dalton et al., 2019; Brown et al., 2023). When the gut microbiome is in a state of dysbiosis, it communicates this via the vagus nerve to the brain, which may generate a response that could lead to inflammation, and systemic inflammation has been linked to a wide variety of health problems including mental health issues (Singh et al., 2022). While the relationship between exercise and improved mental health is well documented, the exact mechanism of how these benefits occur is still being researched, and this gut-brain theory is just one possibility. However, by better understanding at least one

possible mechanism, we may be better equipped to support clients by encouraging these kinds of lifestyle changes to support their mental health.

Another lifestyle change that research has shown can contribute to improved gut and mental health is diet. As discussed in Chapter two, there are many pathways through which our diet may impact our gut microbiome and therefore our mental health. Our diet can impact levels of inflammation in the body, the body's ability to produce and disseminate certain neurotransmitters, as well as the overall quality and health of the microbiome. Olmo et al. (2021) found that recent shifts in eating patterns, typical of a Western diet high in ultra-processed foods, may evoke an immune response in the body, leading to increased neuroinflammation and causing cognitive and psychiatric disorders. This research is also supported by findings that suggest a Mediterranean diet, which is typically high in fruits, vegetables, seafood and whole grains, is linked with lower levels of inflammation and a reduced risk of depression (Horn et al., 2022). While these findings are compelling, van Zonneveld et al. (2024) note that much of the research being done on diet and mental health is observational, so while associations can be formed, we aren't able to establish causation. Counsellors may also need to be careful in suggesting clients make any dietary changes, as food and our relationship to it can be complicated. Fivian and Wood (2018) highlight how language around "clean" or "healthy" foods may promote disordered eating habits and restrictive diets, leading to health concerns similar to those found in eating disorders. As counsellors who are not necessarily educated as dietitians, making recommendations to clients may not be appropriate, however having this knowledge may allow us to point clients who are interested in the right direction. As mental health care moves towards a more holistic approach and an understanding of the importance of the brain-body connection, understanding how what we eat impacts not just our physical health but our mental health as well may become even more important.

Conclusion

This section ties together some of the key outcomes from the research and highlights both how they may be used in work as a counsellor, as well as some gaps in knowledge and areas of concern that arose while doing this research. Understanding that the gut and brain are in constant communication and that many factors, including diet, stress, medication use and environmental pollutants can impact that communication allows us to address client needs from a holistic standpoint. While certain socioeconomic factors may interfere with a client's ability to address these environmental factors, there are also multiple lifestyle factors that can be adjusted to help support clients in both their mental and physical health. As counsellors are likely to help guide clients who are navigating both mental and physical health concerns, understanding this intersection is vital in providing the most helpful and ethical care. The next, and final, section will explore how these findings may be applied to in the real world to help clients improve both their gut health and their mental health.

Application

The basis for beginning this research paper and trying to understand the connection between gut health and mental health came from my own experience working as a mental health worker with individuals living with severe and persistent mental health diagnoses such as schizophrenia and bipolar disorder. The individuals I worked with lived in group home settings and required at least some level of support with obtaining and preparing food on a daily basis. In working with some clients, I would notice that on particular days their functioning was higher and they were better able to navigate social situations and handle stress, while on other days they were not. I also began to pay attention to the foods these clients were consuming, often noticing their meal plans were lacking in fruit and vegetables and relied heavily on premade meals. While I knew many factors were at play and that there was likely not one reason for these fluctuations in functioning, I wondered if there was any

correlation between the foods they were consuming and their level of functioning on any given day. Having completed the research for this assignment, I can now appreciate how complex the interactions between the gut and the brain are but I can see from the research that correlations do exist.

In order to disseminate the information I have learned through the research more widely, I have designed a workshop aimed at educating those who work closely with individuals struggling with their mental health, such as nurses, occupational therapists, counsellors and group home workers. The following sections will discuss the outline of this workshop, including learning objectives, session structure and included modules, resources for participants and expected outcomes, as well as the theoretical foundation this workshop is built on. An example of slides used in this workshop are also included in Appendix A. By further exploring the application of this research, I hope to help others move from seeing this research as simply interesting to how they can conceptualize bringing it into their practice and helping improve the quality of life of their clients.

Workshop Structure

This workshop will be made up of 3 modules and will run for a total of two hours. This workshop is intended to introduce participants (nurses, OT's, counsellors, etc.) to the concept of the gut-brain connection and its importance in mental health, as well as identify environmental factors that could be compromising their clients gut health. It will also provide intervention strategies and resources to further explore the topic. I believe the two hour run time would allow for the workshop to be run during the work day, making it easier for clinicians to attend. I also believe this run time would allow for more participants to be introduced to the topic, as it does not require a huge time commitment and hopefully once introduced, individuals could explore the topic further with the resources they would be given at the end of the session.

Learning Objectives

In designing this workshop, there are eight learning objectives that I hope to introduce to participants at the beginning of the session to help guide their experience. By the end of the workshop, my hope is that participants will:

1. Understand what the gut microbiome is and the pathways by which it communicates with the brain.
2. Understand the relevance of the brain-body connection within our current understanding of mental health treatments.
3. Recognize how imbalances in the gut microbiome show up in the body and brain.
4. Understand which environmental factors could impact gut health and mental health.
5. Understand the importance of diet and other lifestyle factors on improving gut health and mental health.
6. Recognize the impact of gut health on treatment interventions and outcomes.
7. Feel comfortable speaking about lifestyle changes/interventions with clients without going outside of scope.
8. Have resources and recommendations to share with clients and know how and when to make referrals to other health care professionals such as dietitians.

Session Modules

This workshop will be presented via a slideshow presentation, with slides made available to participants following the workshop. The two hour workshop will be divided into 3 modules with a 15-minute break in the middle, followed by a question period.

Module 1 (30 minutes). This section will begin with an introduction of both the instructor and the topic, including learning objectives and the relevance of this topic in the mental health field today. This section will also explore the details of what the gut microbiome is, the role of the vagus nerve and the gut's role in serotonin production. Finally,

it will examine the connection between gut health and mental health by exploring the role of inflammation, the links between gut dysbiosis and anxiety/depression and the influence of the gut microbiome on the HPA axis. This section is primarily focused on education, with some space for comments and questions throughout.

Module 2 (30 minutes). The second module will delve into the environmental impacts on gut health, as well as the lifestyle tools that can be used to help improve gut and mental health. The first part will explore environmental factors that can negatively impact gut/mental health such as stress, medications, substance use, and poor diet. The second part will explore strategies such as limiting ultra-processed foods, exercise and supplementation that can help improve the quality of the gut microbiome and client's mental health. This section will also speak to the impact of gut microbiome on treatment interventions, such as medications.

Break (15 minutes).

Module 3 (45 minutes). This final module will present real clinical applications for the research discussed in the first two modules. This would include recommendations for grocery shopping/preparing meals with or for clients and how to discuss these changes with them, including how to introduce more fibre and fermented foods into their diet. It would also include discussions around exercise routines and stress reduction strategies. This module will also discuss concerns around access to some of these strategies and other barriers for clients to address gut health concerns. Finally, we will look at resources for both clinicians and clients to access, and ensure clinicians feel supported by other health care professionals who have more experience/knowledge around the topic of diet. This section will also include some time for questions and discussions.

Conclusion

As a new clinician entering the mental health field, I hope to be able to provide holistic and individualized care to each client I see. While talk therapy and other counselling strategies will make up the bulk of what I am qualified to provide, I hope this research will inform my work in allowing me to see all the different components that inform what it means to be mentally, and physically, "healthy". I hope to bring the research presented in this paper into my work, particularly for clients who are not finding symptom relief through traditional mental health care methods, such as therapy or medication. I hope in taking this more holistic approach, I will be able to help clients find resources and support that will allow them to address not just the cognitive aspects of their mental health concerns but also the physical issues that may be preventing them from getting relief.

The relationship between the gut and the brain is incredibly complex and there are many areas of the research where the connection is evident, and yet causation is still to be determined (Lucas, 2018). However, while research may not be able to draw clear cause and effect conclusions for every relationship, it does highlight the importance of addressing the human body and brain as one interconnected system, as opposed to using the old "machine" model of the body, in which when one part breaks, we simply fix that part without needing to understand why it broke in the first place (Mayer, 2016). Being trained as a counsellor does not give us the medical background to address the physical needs of clients, however being aware of this research and its impacts on mental health, I believe we can better support clients to seek further support that can address these types of concerns. I hope this information can become more widespread through the mental healthcare field and that both clinicians and clients can use it to better understand how the brain and body communicate and how to use other strategies to better help support clients when traditional methods of treatment aren't effective.

Appendix A

Gut Feelings: New Pathways for Supporting Mental Health

What You Need to Know as a Mental Health Professional

Victoria Klausen

About Me

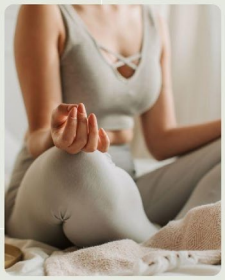
- Master of Counselling Student at City University
- Drawn to this research through both professional work and personal interest
- Previously worked as a Mental Health Worker with adults with severe & persistent mental health concerns.
- Have used food & supplements to address issues of my own
- Interested in the intersection between mental health and physical health and the mind-body connection

Learning Objectives

By the end of this session, you will:

- Understand the gut-brain axis and its role in mental health
- Identify environmental and lifestyle factors that influence gut health
- Learn strategies to support mental health through gut health interventions
- Access resources for clinicians and clients

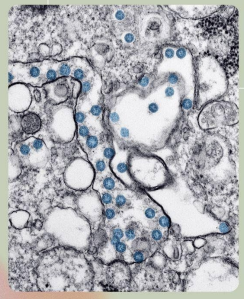
Why This Topic Matters



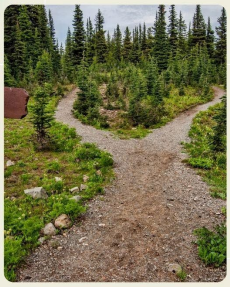
- 1 in 4 people experience mental health disorders
- Current treatments often overlook gut health
- Gut-brain connection = a key piece of holistic care
- Question: Have you considered gut health in mental health treatment?

What is the Gut Microbiome?

- Trillions of microorganisms living in the gut
- Roles: digestion, immune function, neurotransmitter production
- Each microbiome is unique – like a fingerprint



The Gut-Brain Axis



- Two-way communication between gut and brain

Pathways:

- Neural: Vagus nerve
- Hormonal: Stress hormones
- Immune: Inflammation signals

The Vagus Nerve

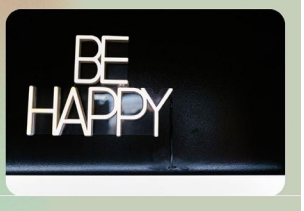
- Main link between gut and brain
- Sends signals about digestion and mood

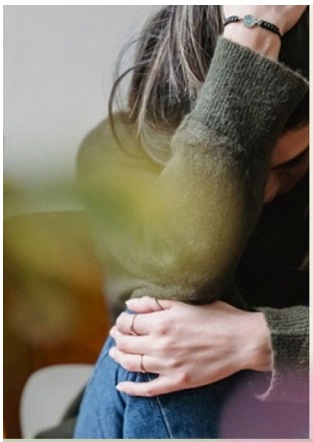
Stimulated by:

- Deep breathing
- Meditation
- Certain foods

Serotonin & the Gut

- 90–95% of serotonin is made in the gut
- Affects mood, sleep, digestion
- Healthy gut = better serotonin balance





Gut Health & Mental Health

Dysbiosis linked to:

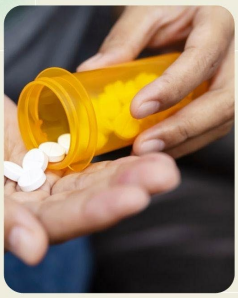
- Anxiety
- Depression

Inflammation and “leaky gut” affect mood

Gut impacts HPA axis → stress response

BREAK

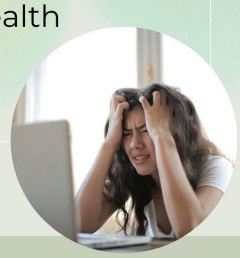
Environmental Impacts on Gut Health



- Stress
- Medications (antibiotics, SSRIs)
- Substance use (alcohol, drugs)
- Poor diet (processed, low fiber)

Stress and the Microbiome

- Stress hormones disrupt gut bacteria
- Cortisol increases gut permeability
- Chronic stress worsens mental health



Lifestyle Strategies

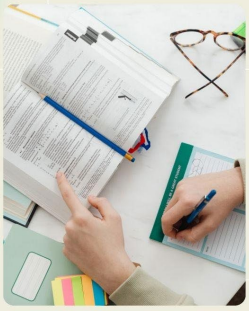
- Limit ultra-processed foods
- Add fiber & prebiotics
- Include fermented foods
- Exercise regularly
- Prioritize sleep & mindfulness

Supplements & Medications

- Probiotics: mixed but promising evidence
- Omega-3 fatty acids
- Medication-gut interactions (SSRIs, antibiotics)
- Collaborate with dietitians or physicians

BREAK

Applying Research in Practice

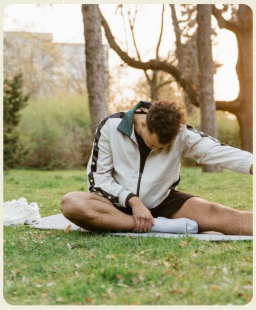


- Start small: 1–2 changes at a time
- Focus on education & empowerment
- Collaborate with other healthcare providers

Practical Tips – Diet

- Encourage fiber-rich foods (fruits, vegetables, whole grains)
- Introduce fermented foods (yogurt, kimchi, sauerkraut)
- Hydration matters!

Practical Tips – Lifestyle



- Movement: daily walking, light exercise
- Stress management: mindfulness, breathing exercises
- Sleep hygiene: regular routine, reduce screens

Barriers & Solutions

Barriers: cost, access, cultural preferences, motivation

Solutions:

- Community resources
- Free apps
- Small, gradual changes

Working Within Scope

- Provide education, not prescriptions
- Use referrals for specialized care
- Avoid fad diets & misinformation

Resources for Clinicians & Clients

- Professional guidelines (APA, dietetic associations)

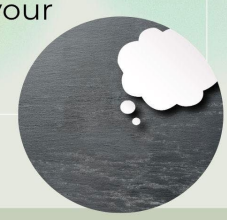
Books & podcasts:

- The Psychobiotic Revolution
- Gut by Giulia Enders
- Referral networks

Discussion & Q&A

What questions do you have?

What's one practical takeaway for your work?



Summary – Key Takeaways

- Gut-brain axis strongly impacts mental health
- Small lifestyle changes make a big difference
- Collaboration is essential
- Stay informed & evidence-based

Thank You!

References

Bonaz, B., Sinniger, V., & Pellissier, S. (2016). Anti-inflammatory properties of the vagus nerve: Potential therapeutic implications of vagus nerve stimulation. *The Journal of Physiology, 594*(20), 5781–5790. https://doi.org/10.1113/JP271539

Clapp, M., Aurora, N., Herrera, L., Bhatia, M., Wilen, E., & Wakefield, S. (2017). Gut microbiota's effect on mental health: The gut-brain axis. *Clinics and Practice, 7*(4), 987. https://doi.org/10.4081/cp.2017.987

Cussotto, S., Clarke, G., Dinan, T. G., & Cryan, J. F. (2019). Psychotropics and the microbiome: A chamber of secrets…. *Psychopharmacology, 236*(5), 1411–1432. https://doi.org/10.1007/s00213-019-5185-8

Cussotto, S., Strain, C. R., Fouhy, F., Strain, R. G., Peterson, V. L., Clarke, G., Stanton, C., Dinan, T. G., & Cryan, J. F. (2019). Differential effects of psychotropic drugs on microbiome composition and gastrointestinal function. *Psychopharmacology, 236*(5), 1671–1685. https://doi.org/10.1007/s00213-018-5006-5

Cussotto, S., Walsh, J., Golubeva, A. V., Zhdanov, A. V., Strain, C. R., Fouhy, F., Stanton, C., Dinan, T. G., & Cryan, J. F. (2021). The gut microbiome influences the bioavailability of olanzapine in rats. *EBioMedicine, 66*, 103307. https://doi.org/10.1016/j.ebiom.2021.103307

Dalton, A., Mermier, C., & Zuhl, M. (2019). Exercise influence on the microbiome-gut-brain axis. *Gut Microbes, 10*(5), 555–568. https://doi.org/10.1080/19490976.2019.1624554

Dutton, D. J., Forest, P.-G., Kneebone, R. D., & Zwicker, J. D. (2018). Effect of provincial spending on social services and health care on health outcomes in Canada: An

observational longitudinal study. *Canadian Medical Association Journal, 190*(3), E66–E71. https://doi.org/10.1503/cmaj.170524

Flanagan, E., Stroh, E., Oudin, A., & Malmqvist, E. (2019). Connecting air pollution exposure to socioeconomic status: A cross-sectional study on environmental injustice among pregnant women in Scania, Sweden. *International Journal of Environmental Research and Public Health, 16*(24), 5116. https://doi.org/10.3390/ijerph16245116

Follwell, E. J., Chunduri, S., Samuelson-Kiraly, C., Watters, N., & Mitchell, J. I. (2021). The quality mental health care network: A roadmap to improving quality mental healthcare in Canada. *Healthcare Management Forum, 34*(2), 100–106. https://doi.org/10.1177/0840470420980040

Freijy, T. M., Cribb, L., Oliver, G., Metri, N.-J., Opie, R. S., Jacka, F. N., Hawrelak, J. A., Rucklidge, J. J., Ng, C. H., & Sarris, J. (2022). Effects of a high-prebiotic diet versus probiotic supplements versus synbiotics on adult mental health: The 'Gut Feelings' randomised controlled trial. *Frontiers in Neuroscience, 16*, 1097278. https://doi.org/10.3389/fnins.2022.1097278

Fu, X., Chen, T., Cai, J., Liu, B., Zeng, Y., & Zhang, X. (2021). The microbiome-gut-brain axis, a potential therapeutic target for substance-related disorders. *Frontiers in Microbiology, 12*, 738401. https://doi.org/10.3389/fmicb.2021.738401

Haripriya, S., Senthilraj, R., & Bupesh, G. (2024). B: On psychobiotics. *International Journal of Biotechnology and Clinical Medicine, 3*(1), 7–12.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169–183. https://doi.org/10.1037/a0018555

Horn, J., Mayer, D. E., Chen, S., & Mayer, E. A. (2022). C: Role of diet and its effects on the gut microbiome in the pathophysiology of mental disorders. *Translational Psychiatry, 12*(1), 164. https://doi.org/10.1038/s41398-022-01962-3

Kovich, M. K., Simpson, V. L., Foli, K. J., Hass, Z., & Phillips, R. G. (2023). Application of the PERMA model of well-being in undergraduate students. *International Journal of Community Well-Being, 6*(1), 1–20. https://doi.org/10.1007/s42413-022-00184-4

Kuhfuß, M., Maldei, T., Hetmanek, A., & Baumann, N. (2021). Somatic experiencing—Effectiveness and key factors of a body-oriented trauma therapy: A scoping literature review. *European Journal of Psychotraumatology, 12*(1), 1929023. https://doi.org/10.1080/20008198.2021.1929023

Leung, C. W., Parnarouskis, L., Slotnick, M. J., & Gearhardt, A. N. (2023). Food insecurity and food addiction in a large, national sample of lower-income adults. *Current Developments in Nutrition, 7*(12), 102036. https://doi.org/10.1016/j.cdnut.2023.102036

Lewandowska-Pietruszka, Z., Figlerowicz, M., & Mazur-Melewska, K. (2022). The history of the intestinal microbiota and the gut-brain axis. *Pathogens, 11*(12), 1540. https://doi.org/10.3390/pathogens11121540

Li, W., Liu, Y., Deng, J., & Wang, T. (2024). Influence of aerobic exercise on depression in young people: A meta-analysis. *BMC Psychiatry, 24*(1), 571. https://doi.org/10.1186/s12888-024-04130-x

Logan, A. C., Nicholson, J. J., Schoenthaler, S. J., & Prescott, S. L. (2024). Neurolaw: Revisiting Huberty v. McDonald's through the lens of nutritional criminology and food crime. *Laws, 13*(2), 17. https://doi.org/10.3390/laws13020017

Lucas, G. (2018). Gut thinking: The gut microbiome and mental health beyond the head. *Microbial Ecology in Health and Disease, 29*(2), 1548250. https://doi.org/10.1080/16512235.2018.1548250

Malan-Muller, S., Valles-Colomer, M., Raes, J., Lowry, C. A., Seedat, S., & Hemmings, S. M. J. (2018). The gut microbiome and mental health: Implications for anxiety- and trauma-related disorders. *OMICS: A Journal of Integrative Biology, 22*(2), 90–107. https://doi.org/10.1089/omi.2017.0077

Mathias, M. (2018). Autointoxication and historical precursors of the microbiome-gut-brain axis. *Microbial Ecology in Health and Disease, 29*(2), 1548249. https://doi.org/10.1080/16512235.2018.1548249

Microbiome, Gut. (n.d.). *ASHLEY ROSE POLOKOWSKI*. https://media.proquest.com/media/hms/PFT/2

Miller, G. E., Engen, P. A., Gillevet, P. M., Shaikh, M., Sikaroodi, M., Forsyth, C. B., Mutlu, E., & Keshavarzian, A. (2016). Lower neighborhood socioeconomic status associated with reduced diversity of the colonic microbiota in healthy adults. *PLoS One, 11*(2), e0148952. https://doi.org/10.1371/journal.pone.0148952

Miller, I. (2018). The gut-brain axis: Historical reflections. *Microbial Ecology in Health and Disease, 29*(1), 1542921. https://doi.org/10.1080/16512235.2018.1542921

Morkem, R., Barber, D., Williamson, T., & Patten, S. B. (2015). A Canadian Primary Care Sentinel Surveillance Network study evaluating antidepressant prescribing in Canada from 2006 to 2012. *Canadian Journal of Psychiatry, 60*(12), 564–570. https://doi.org/10.1177/070674371506001207

Niesler, B., Kuerten, S., Demir, I. E., & Schäfer, K.-H. (2021). Disorders of the enteric nervous system - A holistic view. *Nature Reviews Gastroenterology & Hepatology, 18*(6), 393–410. https://doi.org/10.1038/s41575-021-00430-8

Pferschy-Wenzig, E.-M., Pausan, M. R., Ardjomand-Woelkart, K., Röck, S., Ammar, R. M., Kelber, O., Moissl-Eichinger, C., & Bauer, R. (2022). Medicinal plants and their impact on the gut microbiome in mental health: A systematic review. *Nutrients, 14*(10), 2111. https://doi.org/10.3390/nu14102111

Pigott, H. E., Leventhal, A. M., Alter, G. S., & Boren, J. J. (2010). Efficacy and effectiveness of antidepressants: Current status of research. *Psychotherapy and Psychosomatics, 79*(5), 267–279. https://doi.org/10.1159/000318907

Rogers, G. B., Keating, D. J., Young, R. L., Wong, M.-L., Licinio, J., & Wesselingh, S. (2016). From gut dysbiosis to altered brain function and mental illness: Mechanisms and pathways. *Molecular Psychiatry, 21*(6), 738–748. https://doi.org/10.1038/mp.2016.50

Russell, J. T., Zhou, Y., Weinstock, G. M., & Bubier, J. A. (2021). The gut microbiome and substance use disorder. *Frontiers in Neuroscience, 15*, 725500. https://doi.org/10.3389/fnins.2021.725500

Sen, A., Brazeau, A.-S., Deschênes, S., Melgar-Quiñonez, H. R., & Schmitz, N. (2023). The role of ultra-processed food consumption and depression on type 2 diabetes incidence:

A prospective community study in Quebec, Canada. *Public Health Nutrition, 26*(11), 2294–2303. https://doi.org/10.1017/S1368980023000520

Shoubridge, A. P., Choo, J. M., Martin, A. M., Keating, D. J., Wong, M.-L., Licinio, J., & Rogers, G. B. (2022). The gut microbiome and mental health: Advances in research and emerging priorities. *Molecular Psychiatry, 27*(4), 1908–1919. https://doi.org/10.1038/s41380-022-01431-7

Singh, S., Sharma, P., Pal, N., Kumawat, M., Shubham, S., Sarma, D. K., Tiwari, R. R., Kumar, M., & Nagpal, R. (2022). Impact of environmental pollutants on gut microbiome and mental health via the gut-brain axis. *Microorganisms, 10*(7), 1457. https://doi.org/10.3390/microorganisms10071457

Steenbergen, L., Sellaro, R., van Hemert, S., Bosch, J. A., & Colzato, L. S. (2015). A randomized controlled trial to test the effect of multispecies probiotics on cognitive reactivity to sad mood. *Brain, Behavior, and Immunity, 48*, 258–264. https://doi.org/10.1016/j.bbi.2015.04.003

Steer, E. (2019). A cross comparison between Ayurvedic etiology of major depressive disorder and bidirectional effect of gut dysregulation. *Journal of Ayurveda and Integrative Medicine, 10*(1), 59–66. https://doi.org/10.1016/j.jaim.2017.07.004

Wood, B., Robinson, E., Baker, P., Paraje, G., Mialon, M., van Tulleken, C., & Sacks, G. (2023). What is the purpose of ultra-processed food? An exploratory analysis of the financialisation of ultra-processed food corporations and implications for public health. *Globalization and Health, 19*(1), 85. https://doi.org/10.1186/s12992-023-00965-6

Yan, L.-B., Zhang, J.-Z., Zhou, Q., & Peng, F.-L. (2021). Multidimensional analyses of the effect of exercise on women with depression: A meta-analysis. *Medicine, 100*(33), e26858. https://doi.org/10.1097/MD.0000000000026858

Zonneveld, S. M. van, van den Oever, E. J., Haarman, B. C. M., Grandjean, E. L., Nuninga, J. O., van de Rest, O., & Sommer, I. E. C. (2024). An anti-inflammatory diet and its potential benefit for individuals with mental disorders and neurodegenerative diseases—A narrative review. *Nutrients, 16*(16), 2646. https://doi.org/10.3390/nu16162646