

Introducing Nutritional Psychology

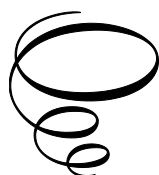
Introducing Nutritional Psychology:

*The Gut-Brain Interaction and
its Effect on Mental Health*

By

Mehrdad Bouyeh

**Cambridge
Scholars
Publishing**



Introducing Nutritional Psychology: The Gut-Brain Interaction
and its Effect on Mental Health

By Mehrdad Bouyeh

This book first published 2026

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Copyright © 2026 by Mehrdad Bouyeh

All rights for this book reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner.

ISBN: 978-1-0364-6450-9

ISBN (Ebook): 978-1-0364-6451-6

TABLE OF CONTENTS

Chapter 1	1
Introduction	
The Brain-Gut Connection.....	2
How Food Influences Mental Health	2
Toward a New Frontier in Mental Health Care.....	3
The Necessity of Writing This Book	3
Chapter 2	5
What Is Nutritional Psychology?	
The Science of Nutritional Psychology.....	5
The Role of a Nutritional Psychologist.....	6
Scope of Practice for Trained Professionals in Nutritional Psychology.....	7
Differences between Nutritional Psychiatry and Nutritional Psychology.....	7
Nutritional Psychology vs. Health Psychology.....	8
The Need for Nutritional Psychology Education among Psychotherapists	8
Using Nutritional Psychology in Treating Mental Disorders.....	9
The Future of Nutritional Psychology.....	10
Future Outlook for Nutritional Psychology Education and Research ..	11
Aiming for Better Mental Health by 2030	11
Introduction to Educational Methods in Nutritional Psychology.....	12
Establishing a New Research-Based Discipline.....	12
References.....	12
Chapter 3	14
The Gut-Brain Connection	
Introduction.....	14
The Link between Stress and Constipation.....	15
Neurotransmitters and the Gut-Brain Axis.....	17
The Impact of Gut Microbiota on Brain Activity	17
Gut Microbes and Inflammation	18
Probiotics, Psychobiotics, Prebiotics, and the Gut-Brain Link	18
Impact of Intestinal Inflammation on Mental Health Disorders	19

Further Explanation: The Vagus Nerve	20
How to Stimulate the Vagus Nerve?.....	21
Signs of Vagus Nerve Dysfunction.....	21
The Potential Effect of Increased Dietary Fiber Intake on Reducing Suicidal Thoughts	22
References.....	24
 Chapter 4	 26
The Gut Microbiota and Mental Health	
Introduction.....	26
The Feedback Loop between the Gut Microbiome, Brain, and Food Choices	26
The Gut Microbiota and Diet Type.....	28
The Gut Microbiota and the Microbiota-Gut-Brain Axis	29
Leptin Resistance	30
Microglia, Leptin Resistance, and the Gut Microbiota	30
Probiotics in Yogurt and Athletic Performance	32
Fermented Foods and Health	33
Loneliness, Wisdom, and Gut Microbiota Diversity.....	34
References.....	34
 Chapter 5	 38
Food and Mood	
The Relationship Between Eating Behavior and Personality/Mood	38
What Guides Our Food Choices	39
The Genetic Basis of Taste Perception and Its Link to Personality Traits	39
Personality and Food Preferences	40
Taste Perception's Influence on Mood and Behavior	40
Taste Perception and Clinical Disorders	41
Food and Mood: A Novel Concept in Mental Health Care.....	41
Hunger and Mood	42
References.....	43
 Chapter 6	 48
Interoception in Nutritional Psychology	
Introduction.....	48
The Insula: A Key Neural Hub	48
Cultivating Interoceptive Awareness (IA)	49
Interoception and the Vagus Nerve: Key Elements in the DMHR	49
Dietary Influences on Interoception.....	50

Cognitive Behavioral Dynamics of Unhealthy Eating.....	51
Refined Grains and Cardiovascular/Mental Health Risks.....	51
Can Positive Emotions Promote Healthy Eating?.....	52
Metabolic Syndrome.....	52
What Influences People to Follow Healthy Diets?	53
References.....	54
 Chapter 7	 58
Brain Neuroplasticity and Nutrients	
Neuroplasticity.....	58
Possibility of Enhancing Positive Neuroadaptations.....	58
The Impact of Diet on Brain Structure and Function.....	59
Psychological and Nutritional Influences on Neuroplasticity	59
Diet and Cognitive Function: Vascular and Metabolic Health	59
Medical and Socioeconomic Implications	61
How Unhealthy Diets Rewire Brain Preferences.....	62
Neural Circuits and Homeostatic vs. Hedonic Eating.....	62
Diet-Mental Health Relationship in Astronauts.....	62
NASA’s HERA Study.....	62
Space Food Evolution.....	63
References.....	63
 Chapter 8	 66
Chronic Stress, the Immune System, and Lifestyle Therapy	
Introduction.....	66
Chronic Stress	66
The Gut Microbiome.....	67
Chronic Social Defeat Stress (CSDS).....	68
Gamma Delta ($\gamma\delta$) T Lymphocytes.....	69
Comparison with Humans.....	70
$\gamma\delta$ T Cells Mediate Social Avoidance	71
Lifestyle Therapy	72
What is Depression?	72
“Lifestyle Therapy” and New Treatments for Depression.....	73
Comparing “Lifestyle Therapy” for Depression with Psychotherapy..	73
References.....	74
 Chapter 9	 78
Eating Behavior, Sleep, and Obesity	
Factors Influencing Food Selection Behavior.....	78

The Western Diet and How It Weakens Appetite-Control	
Satiety Signals.....	79
Interoception: The Body's Communication Network	
for Dietary Regulation.....	80
The Effect of Sleep Deprivation on Obesity	82
The Relationship between Diet and Sleep.....	84
Neuroimaging and Neural Activity Patterns in Obese Individuals	85
Multimodal Magnetic Resonance Imaging (MRI).....	87
The Link Between Unhealthy Childhood Diets	
and Mental Health Risks in Adulthood	91
References.....	92
Chapter 10	95
The Effects of Fats and Sugars on the Nervous System	
The Role of High-Fat Diets in Neurodevelopmental Disorders.....	95
Sugar Consumption and Mental Health	96
Umbrella Review Methodology.....	98
Mechanism of Brain Neurons in Food Palatability	99
Implications for Obesity	100
Artificial Sweeteners Effects on Eating Habits and Mental Health ...	100
References.....	101
Chapter 11	104
Diet, Physical Exercise, and Mental Health	
Introduction.....	104
Gender-Specific Patterns.....	105
Exercise and Disordered Eating in Nutritional Psychology	106
Eating Disorders in Athletes	106
Can Probiotics in Yogurt Help Athletes?.....	107
Diet and Exercise in Nutritional Psychology	109
Enhancing Athletes' Mindset	110
References.....	111
Chapter 12	115
Dietary Diversity and Mental Health	
Dietary Diversity, Stress, and Depression.....	115
The Effect of Whole-Food Diets on Improving	
Depressive Symptoms	116
Developing a Nutritional Screening Tool for Mental	
Health Settings: The NutriMental Screener.....	118
References.....	119

Chapter 13	120
Plants and Mental Health	
Introduction.....	120
Vegetarian Diets and Depression	121
Medicinal Plants and Human Health: Focusing on Mental Health	123
Medicinal Plants: Key Players in Mental Health and Potential Mechanisms.....	123
Saffron (<i>Crocus sativus</i>)	124
Lavender (<i>Lavandula angustifolia</i>)	124
Passionflower (<i>Passiflora incarnata</i>).....	124
Valerian (<i>Valeriana officinalis</i>)	125
Lemon Balm (<i>Melissa officinalis</i>)	125
Chamomile (<i>Matricaria recutita</i> / <i>Chamomilla recutita</i>).....	125
Challenges in Using Medicinal Plants for Mental Health.....	126
Need for Stronger Research Designs	126
Can Medicinal Mushrooms Enhance Human Cognitive Abilities? ...	127
References.....	128
Chapter 14	131
Epigenetics with Emphasis on the Effect of Nutrition on Mood	
Introduction.....	131
Epigenetic Mechanisms in Neural Function	132
Mood Disorders and Epigenetic Alterations.....	132
Nutritional Influences on Epigenetic Regulation	134
Clinical Implications and Future Directions	135
References.....	135

CHAPTER 1

INTRODUCTION

“When you step into an intersection of fields, disciplines, or cultures, you can combine existing concepts into a multitude of extraordinary ideas.”

“Frans Johansson”

Living organisms require a constant supply of energy and certain organic and inorganic molecules for their survival and functioning. The brain and nervous system, like other bodily systems, depend on a continuous intake of these substances. Naturally, the higher an organism’s position in the evolutionary hierarchy, the more active its brain and the greater its role in controlling and interacting with the environment thus, the proportionally higher its energy and nutritional demands. These needs are met through compounds collectively termed “food,” which are ultimately utilized by the body’s cells with the aid of oxygen absorbed from the environment. Given the fundamental and irreplaceable importance of food, evolution has forged a complex, bidirectional relationship between the brain and the gut to ensure adequate and sustained access to nutrients for all tissues. In humans, the expansion of the cerebral cortex - particularly the prefrontal region - has elevated this interplay to its most sophisticated level among animals, even intertwining psychological and emotional states with this axis (known as the gut-brain axis).

For years, the fields of nutrition science, psychology, and psychiatry have evolved as distinct yet burgeoning disciplines, each addressing what appeared to be separate domains: the body’s physical needs and the mind’s psychological demands. However, rapid advances in biochemistry have revealed profound intersections across the life sciences, including these disciplines, culminating in the recent emergence of an interdisciplinary field termed *Nutritional Psychology*, which is rapidly gaining traction. This book primarily focuses on introducing and discussing the scientific findings of this nascent discipline.

The Brain-Gut Connection

The human brain is perpetually “on,” overseeing thoughts, movements, breathing, heart rate, and sensory perception even during sleep. It tirelessly performs its duties, dreams for us, and demands a constant fuel supply. This “fuel” derives from the foods we consume, and the composition of that fuel significantly influences brain structure, function, and, ultimately, mood. Simply put, what we eat directly impacts our brain’s performance and our emotional state.

Much like a high-performance vehicle, the brain operates optimally when fueled with premium-grade nutrients. High-quality foods rich in vitamins, minerals, and antioxidants nourish the brain and shield it from oxidative stress. Free radicals (metabolic by-products of oxygen use) can be likened to exhaust fumes that damage cells. Unfortunately, just as a luxury car sputters on subpar fuel, the brain falters or even sustains damage when deprived of proper nourishment. Low-grade “fuel” (such as processed or refined foods) offers the brain few tools to mitigate harm. For instance, diets high in refined sugars are particularly detrimental. Beyond impairing insulin regulation, they exacerbate inflammation and oxidative stress. Numerous studies correlate refined sugar consumption with impaired brain function—and even worsened symptoms of mood disorders like depression.

Undoubtedly, if the brain is starved of quality nutrition or bombarded by free radicals and inflammatory cells, the consequences can be dire. Given the brain’s diverse responsibilities, such damage may manifest in myriad undesirable ways. Yet, despite these findings, the medical community long hesitated to fully acknowledge the link between diet and mood.

Fortunately, the burgeoning field of nutritional psychiatry and psychology now illuminates not only the connections between food, emotions, and behavior but also the profound influence of gut microbiota on brain function.

How Food Influences Mental Health

Serotonin, a neurotransmitter regulating sleep, appetite, mood, and pain inhibition, is predominantly (95%) produced in the gastrointestinal tract. The gut, lined with 100 million neurons, thus not only aids digestion but also governs emotions. Critically, the function of these neurons - and serotonin production - is deeply influenced by the trillions of “beneficial” bacteria comprising the gut microbiome. These bacteria are vital to human

health: they fortify the gut lining, create barriers against toxins and harmful pathogens, reduce inflammation, enhance nutrient absorption, and activate neural pathways directly linking the gut and brain.

Comparative studies of “traditional” diets (e.g., Mediterranean or Japanese) with the typical “Western” diet reveal a 25–35% lower risk of depression among adherents to traditional patterns. Scientists attribute this to the abundance of vegetables, fruits, unprocessed grains, seafood, and minimal lean meats and dairy in traditional diets—contrasted with the processed, refined sugars and foods dominating Western eating habits. Many traditional foods are also fermented, serving as natural probiotics.

While it may seem improbable, the notion that gut bacteria influence not only digestion but also systemic inflammation, mood, and energy levels is now a focal point of research. These findings dismantle the assumption that psychological and physiological processes operate independently.

Toward a New Frontier in Mental Health Care

Though mental health and nutritional sciences have taken strides in recognizing their overlapping potential, neither has yet fully formalized or widely adopted the role of diet and nutrients in mood, behavior, and mental health. The Center for Nutritional Psychology (CNP), established in the U.S., seeks to accelerate this integration. By coining the term “Nutritional Psychology,” supporting research, and developing academic curricula, CNP aims to pioneer a novel approach to mental health care—equipping professionals with tools to better support emotional and psychological well-being.

The Necessity of Writing This Book

Given the significance of this emerging science for modern, technology-saturated societies - where psychological distress outpaces historical norms - and the global deficiency of specialized scientific references in the field of nutritional psychology, I resolved to compile this book. While undoubtedly imperfect, it is my hope that this work will attract more scholars to the field and, in time, enhance global mental well-being.

I should note that most of content derives from peer-reviewed international studies, supplemented by my interdisciplinary research and theses from my PhD and master’s students. The text balances academic rigor (with citations and methodological details for researchers) and accessibility for general readers. Each chapter concludes with references and further reading.

Certain findings remain provisional, requiring broader validation; their inclusion here highlights the diverse research potential in Nutritional Psychology. To avoid redundancy, foundational concepts in psychology or nutrition (widely available elsewhere) are omitted.

I extend my gratitude to readers and kindly request feedback on errors or omissions for future editions.

CHAPTER 2

WHAT IS NUTRITIONAL PSYCHOLOGY?

Nutritional Psychology was first introduced in the United States in 2005 as an interdisciplinary field. By 2008, it began to be taught in a limited number of academic courses, and in 2015, the “Center for Nutritional Psychology” (CNP) was founded to support the development and advancement of this emerging discipline. This center continues its work in the United States today.

The Science of Nutritional Psychology

In summary, Nutritional Psychology is the study of how dietary patterns influence mood, behavior, and mental health (Figure 2-1 illustrates the bidirectional relationship between the gut and the brain). This field examines the psychological, behavioral, cognitive, perceptual, interoceptive (internal sensory), and psychosocial changes that occur in response to our dietary intake patterns.

To provide a clearer understanding, here are several core elements of Nutritional Psychology explained in more detail:

- **Dietary and Psychological Elements:** This refers to the relationship between nutrient intake and our emotional and psychological states, such as resilience, self-actualization, creativity, negativity, etc.
- **Dietary and Behavioral Elements:** These involve the behaviors, reactions, and choices shaped by our thoughts and emotions, which are in turn influenced by our dietary habits and food environment (e.g., increases or decreases in reactive behaviors based on changes in diet).
- **Dietary and Perceptual Elements:** Our interpretation of information about food, influenced by societal, familial, and cultural factors (e.g., exposure to certain foods and how that shapes our preferences and choices).

- **Dietary and Interoceptive Elements:** Internal physiological sensations experienced in response to dietary patterns (e.g., discomfort, pain, energy, fatigue, cravings).
- **Dietary and Cognitive Elements:** This includes the relationship between nutrient intake and cognitive functions such as memory, attention, concentration, learning, and appetite control.
- **Dietary and Psychosocial Elements:** It examines how family, culture, community, and socio-economic status influence our nutrient intake patterns.

All mental health professionals can benefit from understanding these elements, as together they provide a framework for conceptualizing the relationship between diet and mental health.

The Role of a Nutritional Psychologist

The title of “Nutritional Psychologist” is not yet formally recognized at an academic level. The first academic course in Nutritional Psychology was launched at John F. Kennedy University’s Continuing Education Department in 2008. These programs have trained hundreds of mental health professionals, dietitians, nutritionists, students, nurses, and counselors, equipping them with psycho-educational tools to help clients understand the connection between diet and mental health (referred to as DMHR – Diet-Mental Health Relationship). A next-generation curriculum is currently being developed by the Center for Nutritional Psychology.

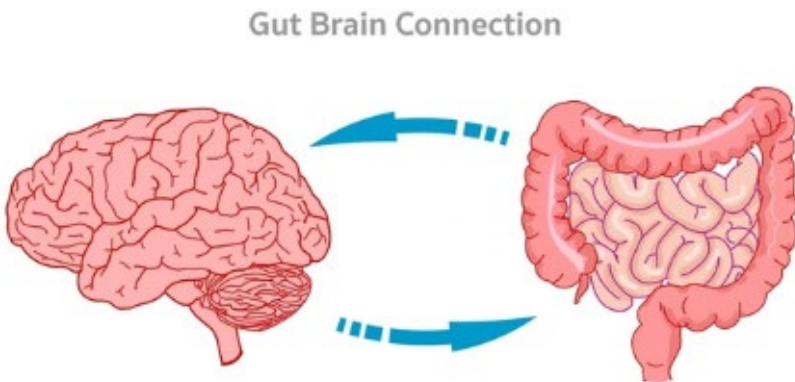


Fig. 2-1 Relation between gut and brain

Scope of Practice for Trained Professionals in Nutritional Psychology

The scope of practice for professionals trained in Nutritional Psychology depends on their licensure (e.g., RD, LCSW, LPCC, MD, licensed psychologist, etc.). This field offers tools to enhance awareness and effectiveness by deepening the understanding of the DMHR. Nutritional Psychology focuses on education - not on intervention - diagnosis, or treatment. Certification in Nutritional Psychology does not authorize professionals without medical licenses to provide nutritional counseling or interventions.

However, those with formal training may offer educational insights into how diet affects mental health and use appropriate psycho-educational tools to raise awareness. Unlicensed individuals must collaborate with licensed professionals when interventions are necessary.

Are All Mental Health Professionals Trained in Nutritional Psychology?

Mental health professionals typically focus on cognitive, behavioral, psychosocial, and emotional factors that support mental well-being. Yet, current educational models rarely incorporate the diet-mental health connection (DMHR). Likewise, nutrition professionals primarily focus on physical health outcomes, often without formal training in how diet influences mental health. Nutritional Psychology has thus emerged to meet the growing need for professionals equipped to understand how diet interacts with psychological, behavioral, cognitive, and social functioning to influence overall mental and physical health.

Differences between Nutritional Psychiatry and Nutritional Psychology

Although there is some overlap between the research focuses of Nutritional Psychiatry and Nutritional Psychology, they are distinct fields. Nutritional Psychiatry is an innovative and emerging discipline that primarily investigates the relationship between diet and mental health. It often involves clinical interventions, including diagnosis and treatment of psychiatric disorders such as depression and anxiety. This field plays a crucial role in advancing our understanding of the diet-mental health.

In contrast, Nutritional Psychology focuses on the development of methodologies and applied research concerning how various foods influence mental health. Every aspect of the interaction between daily dietary patterns and their influence on the Diet-Mental Health Relationship (DMHR) forms the foundation of Nutritional Psychology and aims to

explore how diet can play a positive or negative role in psychological functioning.

Nutritional Psychology vs. Health Psychology

Nutritional Psychology is distinct from Health Psychology. While Nutritional Psychology examines the psychological, behavioral, cognitive, perceptual, interoceptive, and psychosocial factors involved in human dietary patterns, it aligns with principles of integrative health and represents an emerging transformative approach to overall well-being, referred to as “whole health.” This approach empowers individuals to take responsibility for their physical, mental, and spiritual health and to optimize their life in the best way possible.

Health Psychology, on the other hand, studies how biological, psychological, and social factors affect health and illness. Health psychologists use psychological science to promote health, prevent illness, and improve healthcare systems. Although both fields developed independently, they can certainly complement and enrich one another.

The Need for Nutritional Psychology Education among Psychotherapists

There is growing evidence supporting the relationship between dietary composition and psychological, behavioral, cognitive, perceptual, and psychosocial aspects of mental health. Nutritional Psychology utilizes evidence-based research to inform and guide the development of educational strategies aimed at helping individuals understand and implement dietary changes.

While strong scientific evidence supports the use of nutritional interventions for some psychiatric symptoms, many mental health professionals (MHPs) possess limited knowledge in this area. For example, a global survey by Mörkl et al. (2021) collected data from MHPs in 52 countries, including psychologists, psychiatrists, psychotherapists, and students.

This survey assessed general nutrition knowledge, prior nutrition education, learning opportunities, and willingness to recommend dietary supplements and strategies. Most participants (92.9%) expressed interest in expanding their knowledge in nutritional psychiatry, while only 0.8% rated their previous education in nutrition as “very good.” Despite lacking formal academic training, many reported using dietary approaches with clients, with 58.6% recommending supplements and 43.8% suggesting diet-based strategies to their patients. Nutritional approaches to treatment

were most often used to treat eating and emotional disorders, followed by anxiety disorders, psychosis, and obsessive-compulsive disorder.

Most MHPs surveyed had no formal nutrition training, yet their beliefs about diet and mental health aligned with existing scientific data. Many agreed that mental disorders are linked to poor nutrition, a view supported by evidence showing that individuals with mental health challenges often have unhealthy lifestyles, including poor diet choices, irregular eating patterns, and nutritional deficiencies (Teasdale et al., 2019; Gill, 2021). Furthermore, the professionals interviewed often used nutritional approaches to affective disorders, an approach supported by research including a meta-analysis of 16 randomized controlled trials that found that nutritional interventions significantly reduced depressive symptoms, especially when the interventions were delivered by credentialed individuals, particularly nutritionists (Firth et al., 2019).

The authors of the survey hypothesized that psychiatrists may overestimate their nutrition knowledge due to their medical training. This could lead to incorrect dietary advice in some cases. For example, only 40% of U.S. medical schools offer 25 hours of nutrition education (Adams et al., 2006).

Two key insights emerge from this survey: First, many MHPs do not use nutritional interventions either due to lack of awareness or training. Second, while many do apply nutritional strategies, they may lack sufficient knowledge to provide accurate guidance. Thus, incorporating nutrition education into mental health training programs could improve service quality and outcomes.

Using Nutritional Psychology in Treating Mental Disorders

Nutritional Psychology is designed to complement and enhance the effectiveness of standard mental health interventions and treatments. For professionals licensed to diagnose and treat mental disorders, this field offers tools that may assist in the healing process. However, it is important to note that these tools and insights are supportive and should never replace psychiatric, therapeutic, or medical interventions.

Professionals incorporating Nutritional Psychology into their diagnostic and treatment plans should consider the following:

- Ongoing study and awareness of the latest research regarding how dietary intake and nutrients affect psychological, behavioral, cognitive, perceptual, interoceptive, and psychosocial functioning.
- Advanced academic knowledge, typically at a master's level or higher, in psychology, social sciences, or health sciences, including

coursework in advanced psychology and electives in anatomy and physiology.

- Formal education in nutrition via certification or licensure from an accredited academic program.
- Demonstrated experience and training on integrating Nutritional Psychology into their practice in ways that align with their professional scope. They must also be aware of when a referral for psychological or nutritional diagnosis, intervention, or treatment is necessary.

These courses are particularly suitable for dietitians and nutritionists seeking additional training in mental health, as well as mental health practitioners requiring coaching on implementing nutritional techniques.

The Future of Nutritional Psychology

All professions that could benefit from training in Nutritional Psychology are projected to grow faster than average, including dietitians, psychologists, and nutrition therapists. For dietitians, the U.S. Bureau of Labor Statistics (BLS) expects an 11% increase in employment by 2028. This growth is largely due to the role of nutrition in preventing and treating diseases like diabetes. Furthermore, the increasing prevalence of obesity in U.S. adults (42.4% according to NHANES) underscores the need for...

The BLS also notes that older adults nearing retirement are increasingly seeking nutritional services. Expansion in assisted living facilities, hospitals, nursing homes, and private clinics is expected to create additional job opportunities. These needs align with research linking diet to age-related brain disorders.

Employment for psychologists is expected to grow by 14% between 2018 and 2028—much faster than the average for all occupations. Those with doctoral degrees in applied specialties will likely have the best job prospects. Meanwhile, employment for substance abuse, behavioral disorder, and mental health counselors is projected to grow by 22% in the same period.

A 2019 study published in *The Lancet* (based on pre-COVID data) estimated that 1 in 5 global deaths—around 11 million—are linked to poor diet. It emphasized the urgent need for coordinated global efforts to improve dietary quality. Given the complexity of eating behaviors and the many factors influencing diet, improving nutrition requires multi-stakeholder collaboration across the entire food system, along with targeted policy measures.

Future Outlook for Nutritional Psychology Education and Research

Rising rates of chronic conditions linked to diet and mental health suggest that training in Nutritional Psychology can significantly enhance professionals' skill sets while offering crucial support to affected individuals.

While nutrition and mental health have historically been studied separately, they are now increasingly being integrated. As awareness grows, demand for Nutritional Psychology services will continue to rise; especially as new research confirms the link between diet and mental well-being.

Research demonstrates that diet plays a critical role in the mental health of individuals and populations. Nutritional Psychology offers a much-needed framework for mental health and nutrition professionals to jointly address mental health issues.

Aiming for Better Mental Health by 2030

There is a pressing need to better educate both the public and healthcare providers about the connection between diet and all aspects of mental, behavioral, cognitive, and psychosocial health. The Center for Nutritional Psychology (CNP) believes that consolidating global research on the diet-mental health relationship and integrating it into university-level education is vital for building nutrition into mental healthcare by 2030.

From 2008 to 2020, CNP offered the first university-level certification in Nutritional Psychology through John F. Kennedy University. This allowed mental health professionals to gain a better understanding of the diet-mental health relationship (DMHR), particularly the psychological, cognitive, and behavioral dimensions.

CNP is a nonprofit educational organization dedicated to integrating scientific findings about DMHR. Its mission includes clarifying the physiological mechanisms behind this connection and enhancing mental healthcare through education, awareness, and support. Its online evidence base is publicly available for use in developing university-level curricula that blend psychology and nutrition sciences.

The CNP curriculum has been endorsed by several major organizations (e.g., APA, CDR, CAMFT) and includes online video lectures, peer-reviewed educational articles, and a scholarship program to expand access. These resources help raise public awareness of the diet-mental health connection.

Introduction to Educational Methods in Nutritional Psychology

CNP is currently developing a next-generation curriculum in Nutritional Psychology to serve as the foundation for advancing the field. The flagship course draws upon evidence from over 3,000 peer-reviewed scientific publications. It introduces key terminology, concepts, and methodologies needed to understand Nutritional Psychology and integrates them into the traditional education system.

The second and third courses in this introductory series are designed to help learners understand one of the main mechanisms linking diet to DMHR: the microbiota-gut-brain axis (MGBA). These courses also explore other mechanisms beyond MGBA, such as antioxidants, inflammation, oxidative stress, mitochondrial function, neuroplasticity, micronutrients, macronutrients, neurotransmission, neuroanatomy, neurochemistry, and brain processes involved in disease regulation.

Training also includes topics like food consumption, cerebral blood flow, and psychological mechanisms. Completion of these courses earns participants an introductory-level certificate in Nutritional Psychology.

Establishing a New Research-Based Discipline

There is now a substantial body of scientific evidence demonstrating links between diet and various aspects of mental health. Nutritional Psychology lies at the intersection of psychology and nutrition, exploring the many pathways connecting the two. This field is still developing and requires further research, but it has already laid the groundwork for academic and professional programs to deepen understanding and support transformative changes in global mental health.

The CNP (Centre for Nutritional Psychology) curriculum serves learners worldwide, including in Belgium, Canada, Italy, India, Turkey, Nepal, Bermuda, Egypt, Saudi Arabia, the United States, and more. Students range from passionate individuals to postdoctoral researchers in diverse biological and psychological disciplines.

References

- Adams, K.M., Lindell, K.C., Kohlmeier, M. and Zeisel, S.H., 2006. Status of nutrition education in medical schools. *The American Journal of Clinical Nutrition*, 83(4), pp.941S–944S.

- Firth, J., Marx, W., Dash, S., Carney, R., Teasdale, S.B., Solmi, M. and Sarris, J., 2019. The effects of dietary improvement on symptoms of depression and anxiety: a meta-analysis of randomized controlled trials. *Psychosomatic Medicine*, 81(3), pp.265–273.
- GBD 2017 Diet Collaborators, 2019. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, Available at: (<https://doi.org/10.1016/S0140-6736%2819%2930041-8>)
- Gill, R., Tyndall, S.F., Vora, D., Hasan, R., Megna, J.L. and Leontieva, L., 2021. Diet quality and mental health amongst acute inpatient psychiatric patients. *Cureus*, 13(1), p.e12434. (<https://doi.org/10.7759/cureus.12434>)
- Mörkl, S., Stell, L., Buhai, D.V., Schweinzer, M., Wagner-Skacel, J., Vajda, C. and Holasek, S.J., 2021. ‘An apple a day’?: Psychiatrists, psychologists and psychotherapists report poor literacy for nutritional medicine: International survey spanning 52 countries. *Nutrients*, 13(3), p.822. (<https://www.mdpi.com/2072-6643/13/3/822>)
- Teasdale, S.B., Ward, P.B., Samaras, K., Firth, J., Stubbs, B., Tripodi, E. and Burrows, T.L., 2019. Dietary intake of people with severe mental illness: systematic review and meta-analysis. *The British Journal of Psychiatry*, 214(5), pp.251–259.

CHAPTER 3

THE GUT-BRAIN CONNECTION

Introduction

The Gut and Its Nervous System The gut and its nervous system, as far as we know, are not capable of thinking—at least not in the way we expect the process of thinking to occur. However, it is undoubtedly in constant communication with the brain. In other words, the gut-brain connection is a scientific reality with profound effects on both ends. For example, it can lead to significant emotional changes in individuals suffering from Irritable Bowel Syndrome (IBS) or functional gastrointestinal disorders such as constipation, diarrhea, bloating, abdominal pain, and discomfort.

For decades, researchers and physicians assumed that psychological conditions such as anxiety and depression were the root causes of these gut issues. However, recent research indicates that the reverse may also be true. Scientists are discovering evidence that stimulation in the gastrointestinal system can send signals to the central nervous system (CNS), triggering distinct mood changes. Therefore, it is foreseeable that, with advancements in nutritional psychology, gastroenterologists (specialists in digestive disorders) may act as consultants in calming what is sometimes referred to as the “second brain,” while psychologists may incorporate nutrition-based strategies into treating certain psychological conditions.

Modern Medicine and the Gut-Brain Axis The gut-brain axis has become a central topic in modern medicine and evidence-based healthcare. It is grounded in scientific research that demonstrates the bidirectional relationship between the gastrointestinal system and the brain. This research encompasses studies on the gut microbiome, the enteric nervous system, and hormonal interactions.

In contrast, while traditional and complementary medicine also emphasize the importance of the mind-body connection, their approaches are often based on less scientifically validated concepts. For example, traditional practices may stress the role of diet and lifestyle in overall health but might rely on methodologies not widely accepted in modern medical science.

Thus, while both conventional and traditional medicine recognize the mind-body link, the gut-brain axis has evolved within the framework of

scientific research. This complex communication system plays a crucial role in maintaining psychological well-being, stress response, and immune system regulation. The gut microbiome influences hormone production and immune reactions, potentially enhancing or impairing overall health.

Further research in this field may help identify new strategies for disease prevention and treatment, improving quality of life. Maintaining gut health through proper nutrition and a healthy lifestyle can positively impact overall bodily health.

Treating Digestive Disorders For centuries, it has been known that a healthy diet is vital for physical health. Researchers are now exploring whether consuming probiotic-rich foods can improve both gut and mood health. Prebiotics, typically fibers fermented by gut bacteria, may also influence brain function.

One notable study found that taking a prebiotic called galactooligosaccharide for three weeks significantly reduced cortisol—the body’s primary stress hormone. Probiotics that affect the brain are sometimes called psychobiotics. Both probiotics and prebiotics have been shown to reduce anxiety, stress, and depression.

At the same time, recent studies indicate that the brain affects gut health, and vice versa. The communication system linking the gut and brain is known as the gut-brain axis.

Neurophysiology of Gut-Brain Communication The Vagus Nerve and Nervous System Neurons are cells found in the brain and central nervous system (CNS) that dictate how the body behaves. The human brain contains approximately 100 billion neurons. Interestingly, the gut contains around 500 million neurons, which are connected to the brain via the nervous system. The vagus nerve is one of the largest nerves linking the gut and the brain.

It sends signals in both directions. For instance, in animal studies, stress inhibits signals transmitted through the vagus nerve and leads to gastrointestinal issues. Similarly, a human study found that individuals with IBS or Crohn’s disease had reduced vagal tone, indicating impaired vagus nerve function. This underscores the vagus nerve’s critical role in the gut-brain axis and in managing stress.

The Link between Stress and Constipation

Interestingly, many individuals suffering from constipation do not have an identifiable physical cause. Instead, high stress levels can disrupt normal bowel function, making waste elimination difficult. Therefore, we can conclude that a strong connection exists between the brain and the gut (see

Figure 3-1). Individuals experiencing these disruptions should promptly seek expert guidance to manage their stress levels, thereby alleviating digestive symptoms.

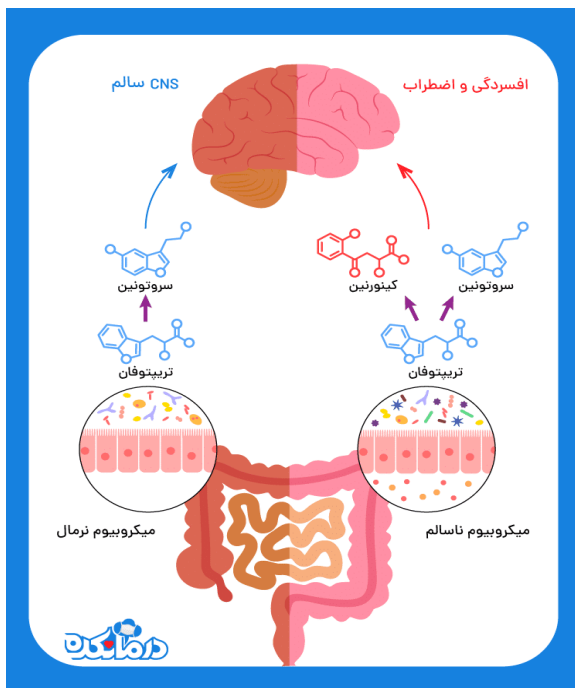


Fig. 3-1 Overgrowth of harmful gut bacteria can produce compounds that trigger stress and depression.

Foods That Support the Gut-Brain Axis Certain food groups are particularly beneficial to the gut-brain connection:

- Omega-3 fatty acids
- Fermented foods
- High-fiber foods
- Polyphenol-rich foods
- Tryptophan-rich foods

Consuming these foods may help maintain normal gut and brain function and prevent the development of related disorders.

How the Brain and Gut Communicate The term gut-brain axis refers to the physical and biological communication between these two organs. The human brain contains about 100 billion neurons, some of which monitor intestinal activity. To maintain gut health, it is advisable to consume natural, healthy foods, and consult with a nutritionist if necessary.

The Vagus Nerve and the Gut-Brain Axis The human brain has approximately 100 billion neurons, while the gut contains around 500 million neurons that connect to the brain via a neural network. The vagus nerve is the largest in the body and facilitates this two-way communication.

Animal studies show that stress signals are transmitted via the vagus nerve and often cause digestive problems. Moreover, individuals with IBS or Crohn's disease exhibit significantly reduced vagal activity. In one study with mice, probiotic consumption reduced anxiety. However, when the vagus nerve was deactivated, the probiotics had no calming effect. These findings highlight the vagus nerve's essential role in stress regulation and gut-brain communication.

Neurotransmitters and the Gut-Brain Axis

The brain and the gut also communicate through **neurotransmitters**, which regulate mood and emotions in the brain. For instance, **serotonin** is a neurotransmitter that contributes to feelings of happiness and also helps regulate the body's circadian rhythms. Interestingly, a large proportion of serotonin is produced in the gut, not the brain, by gut cells and trillions of microbes.

The gut also produces **gamma-aminobutyric acid (GABA)**, a neurotransmitter that helps control feelings like fear and anger. Some studies suggest that appropriate probiotic intake may increase GABA production, potentially alleviating anger and reducing depression-like behaviors.

The Impact of Gut Microbiota on Brain Activity

The **gut microbiota**—the vast community of microorganisms residing in the intestines—produces chemical substances that directly affect brain function. These microbes produce large amounts of **short-chain fatty acids (SCFAs)** such as butyrate, propionate, and acetate by fermenting dietary fiber. These SCFAs influence various brain functions, including appetite regulation.

One study found that **propionate** production may reduce cravings for high-energy foods. **Butyrate**, another SCFA, and its microbial producers, generate substances that affect brain function. Additionally, gut microbes

metabolize **bile acids** and **certain amino acids**, producing compounds that influence the brain. Bile acids, which are produced in the liver, normally help digest fats but also appear to have neurological implications.

Gut Microbes and Inflammation

The gut and brain also interact via the **immune system**, with gut microbes playing a critical role in managing what enters and exits the body. An underactive immune system can lead to **chronic inflammation**, which is linked to neurological disorders like **depression** and **Alzheimer's disease**.

A harmful compound called **lipopolysaccharide (LPS)**, produced by certain gut bacteria, can induce inflammation. When the intestinal barrier is compromised—leading to a “leaky gut”—LPS and harmful bacteria may enter the bloodstream, causing acute inflammation. Such events can trigger mental health disorders, including depression, dementia, and **non-genetic schizophrenia**.

Probiotics, Psychobiotics, Prebiotics, and the Gut-Brain Link

Beneficial gut bacteria help support brain health. Optimizing these bacteria can improve brain function. **Probiotics** are live, beneficial bacteria that, when consumed in proper amounts, enhance brain function. Not all probiotics are the same—those that specifically support mental well-being are termed **psychobiotics**.

Research indicates that psychobiotics may reduce stress, anger, and depression. One study showed that regular consumption of *Bifidobacterium longum* for six weeks significantly alleviated symptoms in patients with IBS and depression.

Prebiotics are types of fiber fermented by gut bacteria and are also linked to brain health. In one study, a prebiotic called **galactooligosaccharide**, taken for three weeks, lowered **cortisol** levels and reduced signs of stress.

What Foods Help Strengthen the Gut-Brain Connection?

Several food types directly support the gut-brain axis:

- **Omega-3 fatty acids:** Found in fatty fish and some plant sources, these support the growth of beneficial gut bacteria and may prevent brain disorders.
- **Fermented foods:** Yogurt, kefir, sauerkraut, and soft cheeses contain lactic acid-producing bacteria that improve brain alertness and function.

- **High-fiber foods:** Whole grains, nuts, seeds, fruits, and vegetables foster the growth of beneficial gut microbes. **Prebiotics** in fiber also reduce stress hormone production.
- **Polyphenol-rich foods:** Cocoa, green tea, olive oil, and coffee are rich in plant compounds that nourish beneficial bacteria and improve gut function.
- **Tryptophan-containing foods:** This amino acid, found in foods like duck, eggs, and cheese, is converted into serotonin in the body, improving mood and cognition.

In summary, the brain and gut maintain a **biochemical and physical relationship**. Millions of neurons communicate daily between the two. Neurotransmitters and other chemicals produced in the gut influence brain function. Enhancing gut health by targeting specific microbes can improve mental performance. **Omega-3s, fermented foods, probiotics, and polyphenols** all contribute to a healthier gut—and, consequently, a healthier brain.

Impact of Intestinal Inflammation on Mental Health Disorders

Recent studies in mice suggest that **disruptions in the gut-brain connection** can negatively affect mental health in individuals suffering from **inflammatory bowel disease (IBD)**. Approximately **30%** of patients with IBD also experience **depression, anxiety, or both**.

IBD involves **chronic inflammation** in the gastrointestinal tract. There are two main types:

- **Crohn's disease**, which can affect any part of the GI tract.
- **Ulcerative colitis**, which primarily affects the colon and rectum.

Common symptoms include persistent diarrhea, abdominal pain, weight loss, and fatigue. Although the chronic pain and discomfort associated with these diseases can increase the risk of mental disorders, **they are not the sole cause** of psychological issues in IBD patients.

According to **Dr. Gerard Honig**, lead researcher at the Crohn's and Colitis Foundation in New York, while the impact of IBD on quality of life clearly plays a role in triggering anxiety and depression, **growing evidence suggests a direct biological link** between inflammation and neuropsychiatric disorders. Stress, anxiety, and depression can themselves exacerbate gut symptoms, creating a **vicious cycle**.

A new study shows that IBD **directly affects the brain** by disrupting the **gut-brain axis**. As mentioned earlier, this axis is a bidirectional communication system between the gut and the central nervous system (CNS), largely influenced by the **gut microbiota**.

This study revealed that gut inflammation may close a crucial **gateway** in this system—one that regulates the exchange of signals between the **bloodstream** and **cerebrospinal fluid** (CSF). This action may be a defensive measure to prevent the spread of inflammation to the brain. However, in the IBD mouse model, **blocking this gateway impaired memory and triggered anxiety-like behaviors**.

Further Explanation: The Vagus Nerve

The **vagus nerve (VG)** is the **longest cranial nerve**, extending from the **brainstem** to the **colon**. It plays a crucial role in regulating various bodily functions, including **heart rate**, **digestion**, and **respiration**, and significantly influences **emotional well-being**. When activated, it can **reduce anxiety levels**.

The vagus nerve is a core component of the **parasympathetic nervous system**, which governs **involuntary body functions** such as breathing, digestion, heart rate, and immune response. It also plays a vital role in the **“fight or flight”** response and, when activated, helps to **lower heart rate, reduce stress, and induce calmness**.

Research has shown that the vagus nerve is involved in a wide range of health and psychological conditions:

- **Depression and Anxiety:** Vagus nerve stimulation (VNS), a therapy approved by the **U.S. FDA**, involves implanting a device to stimulate the nerve and has been shown to **alleviate treatment-resistant depression and anxiety**.
- **Inflammation:** The vagus nerve has **anti-inflammatory properties** and regulates immune responses. VNS has demonstrated reduced inflammation in chronic conditions like **arthritis, asthma, and Crohn’s disease**.
- **Autoimmune Disorders:** The vagus nerve plays a role in **autoimmune diseases** such as **rheumatoid arthritis** and **multiple sclerosis (MS)**. VNS has been shown to reduce disease severity in animal models.
- **Gut-Brain Axis:** The vagus nerve is a **key mediator** between the brain and the gut microbiome. It helps regulate microbial composi-