PERSPECTIVES

Gastrointestinal Health: A Foundation for Whole-body Wellness

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ABSTRACT

Contenxt • The focus on gastrointestinal (GI) health has been increasing due to a growing awareness of its pivotal role in overall well-being. Current trends in addressing GI health aim to optimize gut-microbiome composition, understand the bidirectional communication between the gut and the brain, and use functional diagnostic testing to aid in diagnosis and guide treatments for GI disorders. **Objective** • The study intended to examine advances in microbiome research, including advancements in technology, and to investigate methods of noninvasive diagnostics, the importance of the gut-brain axis (GBA) and the oral cavity, the types of beneficial microorganisms, and the prevalence of functional GI disorders (FGIDs). **Setting** • The study took place at Biocidin Botanicals in Watsonville CA, USA.

Results • Recent research has illuminated the critical role that gut health plays in human physiology and disease. Also, the oral cavity is emerging as a vital microbial reservoir affecting both GI and systemic health. Dietary patterns and lifestyle choices exert profound effects on the gut microbiota and host metabolism, emphasizing the importance of holistic approaches to GI care. FGIDs impose significant burdens on patients' quality of life and the healthcare systems. Integrating stress management strategies and supporting healthy lifestyle choices are essential for managing FGIDs effectively. **Conclusions** • Functional foods, prebiotics, probiotics, and postbiotics offer promising avenues for optimizing GI health and mitigating disease risk. (*Altern Ther Health Med.* 2024;30(7):6-10).

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Over the past several years, the focus on gastrointestinal (GI) health has been increasing due to a growing awareness of its pivotal role in overall well-being. While this concept isn't new to naturopathic doctors and other integrative, complementary, and alternative-healing practitioners, research continues to uncover the intricate connections between gut health and various aspects of human physiology.

The significance of maintaining a well-functioning GI system has caught the attention of those in the scientific, medical, and public-health fields of study. Numerous factors contribute to a person's gut health, from diet and stress levels—influencing not simply digestive functions but also immune-system activity—to mental health and even the presence of chronic disease.

Diet, nutrition, and lifestyle modifications are some of the best approaches for supporting GI health, and by extension, whole-body health. However, current trends in addressing GI health reflect a deeper understanding and more targeted approach. These treatment trends aim to optimize gut-microbiome composition, understand the bidirectional communication between the gut and the brain, and use functional diagnostic testing to aid in diagnosis and guide treatments for GI disorders.

MICROBIOME RESEARCH

Microbiome research has expanded rapidly over the last few decades, shedding light on the profound influence that gut microbiota have on various aspects of health, including digestion, metabolism, immunity, and even neurological function. On and within the human body are complex ecosystems in which trillions of microorganisms coexist with the host. The microbiome ultimately encompasses all these organisms and the genes and gene products that inhabit almost all human body parts.

Advancements in technology have allowed for whole-genome sequencing of microorganisms, resulting in the acquisition of an exponential amount of genetic information from microbes. Over 130 000 complete or near-complete bacterial genomes have been sequenced.[1] In addition to the microbiota, the vast number of microbial genes—on the order of 50- to 100-fold more genes[1]—can produce a dizzying array of metabolites that may affect host physiology. One such technological advancement is mass-spectrometry-based metabolomics. This technology can detect and identify the small molecules produced in the human microbiota, broadening the understanding of how these microbial metabolites function and their roles in human physiology.[2]

The expansion of information related to the collection of microbes and their metabolites has laid the foundation for revolutionary advances in the knowledge of human microbial systems. By understanding the interacting networks of microbes and their biological molecules—including genes and proteins—at the systems level, health practitioners can effectively manipulate the ecosystems to impact human physiology and health.

Barko et al have provided definitions of terms and described methods of analysis as below.[3]

Definitions

Dysbiosis. Dysbiosis involves changes in the composition of the microbiome associated with diseases or conditions that alter microbe-host homeostasis. Dysbiosis is characterized by a reduction in microbial species' diversity, changes in the intestinal and systemic inflammatory milieu, and altered metabolic relationships between the microbes and host.

16S ribosomal gene region. This region is a universally conserved gene region with hypervariable sequences that differ between species. Amplification and sequencing of this gene region permit identification of microbial organisms. Sequencing to the 16S rDNA has revolutionized the field of microbiomics since many of its constituents can't be cultured.

Diversity. Diversity is a measure of the microbiome's variability, considering the richness and relative abundance of OTUs. Alpha diversity is the diversity within an individual sample, and beta diversity is the diversity between different samples.

Richness. Richness is a measure of the overall number of unique OTUs present in a sample.

Operational taxonomic units (OTUs). Examination of operational taxonomic units (OTUs) provides a method of analyzing 16 rDNA sequencing data based on sequence similarity. An OTU is an organizational proxy for a species created by statistical clustering of OTUs with a high sequence similarity, typically >97%.

Microbiomics. Microbiomics is an investigative field focused on the study of communities of microorganisms in a variety of ecologic systems, including the body.[4] The goals of such biologic studies include: (1) identification of constituent organisms and their phylogenetic relationships, (2) analysis of the microbial genome, (3) characterization of host-microbe relationships and microbial determinants of host development and health; (4) elucidation of microbial contributions to disease pathophysiology; (5) discovery of novel biomarkers, and (6) development of novel therapeutic approaches to address microbe-host relationships in disease states.[3]

Metagenomics and Metatranscriptomics. Metagenomics and Metatranscriptomics involve advances in sequencing technology and computational tools that permit the analysis of the content of the collective microbial genome and gene expression. This approach yields valuable data related to the microbial community's metabolic capacity as well as its potential interactions with the host.

Metabolomics. Researchers use mass spectrometry and nuclear magnetic resonance spectroscopy to identify the composition of small molecules in a sample. Metabolomic analysis permits investigators to analyze the metabolic interactions between the microbiome and host, identify pathophysiologic pathways, and detect novel biomarkers.

NONINVASIVE GI DIAGNOSTICS

While conventional medical settings still commonly use stool cultures for overt pathogen identification, technological advancements have revolutionized how practitioners diagnose and treat GI disorders. From noninvasive microbiome testing to comprehensive digestive stool analysis, innovations in GI healthcare enable more precise diagnoses, personalized treatment plans, and improved patient outcomes.

Microbiomics uses fecal-based, noninvasive microbiome testing to identify the abundance and diversity of microbes in a sample, analyze the genomic content, and interpret the microbiome's possible association with dysfunction or disease.

The development of high-throughput DNA sequencing technologies, together with bioinformatics advances, has transformed the field of microbiomics.

As Barko et al explained, "High-throughput DNA sequencing technologies involve amplification and sequencing of targeted microbial DNA regions followed by statistical analysis of microbial identity and diversity based on sequence similarity and comparisons to reference microbial genomic databases. For bacteria, these methods target the 16S ribosome gene—16S rDNA."[3]

Whole-genome shotgun sequencing allows for taxonomic analysis, determining microbial gene sets and identifying nonbacterial microbes excluded from 16S rDNA sequencing.[3]

Beyond microbiome testing, many naturopathic, functional, and integrative practitioners use comprehensive digestive stool analysis. These tests—which often use polymerase chain reaction (PCR), cultures, and microscopic testing—measure key markers of digestion, absorption, intestinal function, intestinal inflammation, and microbial flora and identify pathogenic bacteria, parasites, and yeasts. Test results provide a more specific and detailed understanding of a person's GI function and health and permit more personalized treatment.

THE GUT-BRAIN AXIS

Understanding how microbes in the gut influence brain health and cognitive function is one of the most exciting areas of research in neuroscience and biological psychiatry today. This dynamic and bidirectional communication network, known as the gut-brain axis (GBA), facilitates a complex coordination of neural, hormonal, and immunological interactions that influence various physiological processes beyond digestive function.

The GBA's network of neural pathways connects the central nervous system (CNS), the neuroendocrine and neuroimmune systems, the sympathetic and parasympathetic components of the autonomic nervous system, the enteric nervous system (ENS), and the gut microbiome, coordinating a complex interplay between gut function and brain activity.[4]

GBA plays a pivotal role in regulating mood, metabolism, and immune function, according to research, and may even influence higher cognitive functions such as memory, learning, and decision-making.[5] Emerging evidence also suggests that disturbances in gut-brain communication may contribute to the pathogenesis of a wide range of neurological and psychological disorders, including depression, anxiety, dementia, and irritable bowel syndrome (IBS).[6] Strategies that promote harmonious support for the gut-brain axis, such as reducing stress and supplementing with probiotics, are integral to maintaining optimal GI health.

THE ORAL CAVITY

As one of the body's largest microbial reservoirs, the oral cavity is an integral part of the GI tract. A flourishing oral microbial community is essential for both oral and systemic health. Oral microbial dysbiosis contributes to GI disorders and systemic diseases, including inflammatory bowel disease (IBD), Alzheimer's, diabetes and obesity, polycystic ovary syndrome, rheumatoid arthritis, and atherosclerosis, among others.[7]

Educating patients about the connection between oral health and systemic health is essential, as is encouraging regular dental visits and cleanings. Dental practitioners must also teach and encourage good oral hygiene, including flossing, brushing, and rinsing and now even oral probiotics.

BENEFICIAL MICROORGANISMS

Functional foods and probiotics containing beneficial microorganisms are increasingly incorporated into diets to enhance GI health. Probiotics, in particular, have the potential to restore microbial balance, alleviate digestive discomfort, and bolster immune function. Moreover, prebiotics—nondigestible fibers that fuel the growth of beneficial bacteria—are gaining attention for their role in nurturing a healthy gut. Lastly, postbiotics and paraprobiotics are the latest approaches to using microbial supplements to impact the microbiome and human physiology.

Certain categories of foods that contain biologically active components have the potential to modify disease mechanisms either prophylactically or therapeutically, and these foods are often referred to as nutraceuticals or functional foods. Functional foods have grown to include a wide range of health-promoting ingredients and bioactive compounds such as probiotics, prebiotics, resistant starches, phytochemicals or herbs, natural antioxidants, and bioactive peptides.[8]

Probiotics and fermented foods containing live probiotic organisms are some of the most studied and used functional food ingredients. Probiotics are "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host."[9] Research associated with probiotics continues to show positive outcomes related to numerous conditions and diseases, from gastrointestinal to cardiovascular to neurological.[10,11]

More recently, probiotic-derived biomolecules, or postbiotics, as well as nonviable paraprobiotics known as *ghost* probiotics, have received increasing attention. These emerging categories in functional foods potentially provide further health-promoting properties. Postbiotics are beneficial bioactive compounds that probiotic bacteria produce after consuming prebiotic fiber. Often, postbiotics are created from probiotics that have been grown in a nutrient solution, inactivated or killed, and then centrifuged to leave behind a cell-free supernatant that may include enzymes, proteins, short-chain fatty acids, vitamins, amino acids, peptides, and organic acids. Similarly, paraprobiotics are nonviable or inactivated probiotics that are often crude-cell extracts that haven't received processing to remove the cells or cell fragments but that confer health benefits to the host.[8]

DIET, NUTRITION, AND LIFESTYLE

Dietary patterns play a crucial role in shaping the composition and function of the gut microbiota and the metabolites they produce. In early childhood, diet appears to significantly impact disease risk later in life. Highly processed foods can increase the risk of developing inflammatory bowel disease or colorectal cancer,[12] which is thought to be mediated by modifications to gut microbiota.[13]

Alternatively, when GI concerns are present, dietary choices affect symptoms and disease activity and may be a risk factor for ongoing disease.

Compounds derived from the diet, such as fibers, proteins, fats, and polyphenols not digested by human enzymes, act as substrates for gut microbiota metabolism, influencing the human metabolome and physiology.[14] Trends in GI health emphasize the consumption of a fiber-rich, plant-based diet abundant in fruits, vegetables, whole grains, and fermented foods to support a thriving gut ecosystem. Diets that include fibers, especially prebiotic fibers, seem to benefit the metabolome profile the most. Such diets result in increased production of short-chain fatty acids and decreased levels of potentially damaging molecules—such as p-cresyl sulfate, indoxyl sulfate, and trimethylamine N-oxide—that are involved in disease states.[14]

Lifestyle factors such as chronic stress, sedentary behavior, and tobacco use can disrupt gut function and compromise microbial diversity. This highlights the importance of adopting holistic lifestyle practices conducive to GI well-being. Elevated cortisol due to stress can affect the gut microbiota by altering gut transit time, intestinal permeability, and nutrient availability, which can affect the microbiome's composition and diversity.[15] A sedentary lifestyle and lack of exercise may significantly influence microbial populations associated with obesity.[16] Smoking contributes to modifications of the oral, lung, and gut microbiomes, leading to various diseases such as periodontitis, asthma, chronic obstructive pulmonary disease, Crohn's disease, ulcerative colitis, and cancers.[17]

It's important to recognize and emphasize preventive approaches to safeguarding GI health. Promoting a healthy, fiber-rich diet, adequate water intake, exercise and movement, and stress-reduction practices and minimizing exposure to exogenous toxins can help reduce a patient's risk for disease. Furthermore, age-appropriate routine screenings for colorectal cancer and other GI conditions, as well as early intervention to address risk factors, such as obesity, alcohol consumption, and smoking, can have profound implications for GI well-being.

FUNCTIONAL GI DISORDERS

Functional GI disorders (FGIDs) affect approximately 65% of adults in the USA and up to 40% of adults worldwide.[18] They are one of the main complaints seen in medical practice. Often, this disorder lacks a distinct organic explanation. In FGID, the GI tract looks normal upon examination; however, nonspecific symptoms are present, making a definitive diagnosis challenging. These may include abdominal pain, heartburn and indigestion, nausea, vomiting, diarrhea, and constipation.

Patients with FGIDs tend to have a very low quality of life and incur significant healthcare costs. For those reasons, it's vital to recognize and manage these disorders promptly.[19]

Epidemiology

FGIDs are more common in women than men and account for 12% of primary care visits and 30% of gastroenterology outpatient visits.[19] FGIDs are associated with serious GI diseases such as inflammatory bowel disease (IBD)and cholecystitis.[20] These conditions share the common underlying risk factor of dysbiosis, which creates additional impacts related to quality of life and healthcare.[21] In the USA, GI diseases cost $135.9 billion annually (Table 1). Nonmalignant GI diseases account for 97 700 deaths every year.[22]

Physiology and Clinical Relevance

Health practitioners use symptom-based criteria to make a diagnosis of FGID, with judicious use of limited testing in some patients.[23] These conditions, which include IBD or functional dyspepsia, frequently involve some combination of the following: (1) abnormal GI motility—constipation, diarrhea, or alternating constipation and diarrhea; (2) visceral hypersensitivity; (3) altered mucosal immune function (4) disrupted GBA communication; (5) altered central-nervous-system processing; and (6) imbalances or dysbiosis in the microbiome.

Psychological comorbidity is common; however, whether pyschological disorders predate FGIDs or FGIDs drive symptoms isn't clear.[23] Stress particularly influences GI function. Human studies show that stress decreases gastric emptying and accelerates colonic transit for participants.[24] Additionally, emotional distress is common in IBS patients, particularly those who seek medical treatment for the condition, with anxiety and depression occurring in nearly 40%.[25]

Including stress-management strategies for FGID patients is a foundational therapy. Suggested practices include yoga and stretching, deep breathing, meditation, journaling, and time in nature and with loved ones.

MIGRATING MOTOR COMPLEX (MMC)

Many FGID patients have deranged motility symptoms, as seen in IBS, with diarrhea, constipation, or a mix. This can be related to mechanical function, such as from low stomach acid, pancreatic insufficiency, or cholestasis, irritation to the GI mucosa, such as from dysbiosis, food sensitivities, or celiac disease, or disruption of neurological activity in the peripheral—gut mucosa—or central nervous system.

The MMC involves both the CNS and the enteric nervous system. It's a cyclic, recurring motility pattern that occurs in the stomach and small bowel during fasting and that eating interrupts. The physiological role of the MMC isn't entirely understood, though it's considered to be an intestinal housekeeper, responsible for moving undigested food and microbes from the small intestine into the colon. Its absence has been associated with gastroparesis, intestinal pseudo-obstruction, and small intestinal bacterial overgrowth.[26]

Supporting healthy motility is essential and may include meal spacing, at least 3-5 hours, and using nutraceuticals, botanicals, or pharmaceuticals.

CONCLUSIONS

Recent advancements in microbiome research, noninvasive diagnostic techniques, and the understanding of the intricate connections of the gut-brain axis (GBA) have illuminated the critical role that gut health plays in human physiology and disease. The oral cavity, often overlooked, is emerging as a vital microbial reservoir affecting both GI and systemic health. Dietary patterns and lifestyle choices exert profound effects on the gut microbiota and host metabolism, emphasizing the importance of holistic approaches to GI care.

Increasingly common yet challenging to diagnose definitively, FGIDs impose significant burdens on patients' quality of life and the healthcare systems. Integrating stress management strategies and supporting healthy lifestyle

Table 1.

		Estimated Number of Annual Visits		
Rank	**Symptoms**	**Office Visits**	**Emergency Dept.**	**Total**
1	Abdominal pain	10,705,448	11,135,099	21 840 547
2	Vomiting	1,725,616	2,936,210	4 661 826
3	Diarrhea	2,423,825	994,454	3 418 279
4	Nausea	1,063,883	2,004,732	3 068 615
5	Bleeding	2,147,949	606,970	2 754 919
6	Constipation	1,086,452	511,317	1 597 769
7	Anorectal symptoms	928,119	220,585	1 148 704
8	Heartburn and indigestion	878,808	63,485	942 293
9	Decreased appetite	564,112	94,685	658 797
10	Dysphagia	537,975	88,731	626 706
Total				40 718 4555

choices are essential for managing FGIDs effectively. Working collaboratively with patients and practitioners when treating these disorders can promote optimal GI health and overall well-being.

Functional foods, prebiotics, probiotics, and postbiotics offer promising avenues for optimizing GI health and mitigating disease risk.

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