Brain–Gut Interactions and Maintenance Factors in Pediatric Gastroenterological Disorders: Recommendations for Clinical Care

Bonney Reed-Knight  
Children’s Healthcare of Atlanta, Atlanta, Georgia, Department of Pediatrics, Emory University School of Medicine, and GI Care for Kids, Atlanta, Georgia

Michele H. Maddux and Amanda D. Deacy  
Children’s Mercy Kansas City, Kansas City, Missouri, and University of Missouri, Kansas City

Katherine Lamparyk  
Cleveland Clinic Children’s Center for Pediatric Behavioral Health, Cleveland, Ohio

Amanda L. Stone  
Vanderbilt University

Laura Mackner  
Nationwide Children’s Hospital, Columbus, Ohio

Pediatric gastrointestinal (GI) disorders are frequently encountered by the practicing pediatric psychologist and can be challenging to treat due to the range of presenting symptoms and potentially high impact on patient’s functioning. In this article, the authors aim to (a) describe the brain–gut axis as a means to increase understanding among pediatric psychologists of the biological mechanisms implicated in pediatric GI disorders and how their interactions with psychological and contextual factors maintain GI symptoms and (b) provide practical ways for pediatric psychologists to incorporate the discussion of biological mechanisms and the brain–gut axis into patient education and psychological interventions. Biological mechanisms of the brain–gut axis including alterations in pain processing, the stress response system, and gut microbiome activity will be reviewed. Psychosocial factors that contribute to or maintain disturbances in the brain–gut axis are discussed with implications for clinical assessment and intervention. The authors assert that a mutual understanding by patients, families, and providers alike of the relevant brain–gut interactions and the biopsychosocial model, in general, will serve as a foundation for successful delivery of and adherence to psychological intervention.

Keywords: gastroenterology, conceptualization, brain–gut axis
Although pediatric psychologists are trained to recognize the psychosocial factors commonly affecting children’s physical and emotional health across a range of chronic illnesses, discussions of the cross-diagnostic biological factors at play have largely been confined to illness-specific, medical, and psychophysiology journals, particularly for GI disorders (Bielefeldt, Davis, & Binion, 2009; Mayer & Tillisch, 2011; Wouters & Boeckxstaens, 2016). Our article aims to (a) describe the brain–gut axis as a means to increase understanding among pediatric psychologists of the biological mechanisms implicated in pediatric GI disorders and how their interactions with psychological and contextual factors maintain GI symptoms and (b) provide practical ways for pediatric psychologists to incorporate the discussion of biological mechanisms and the brain–gut axis into patient education and psychological interventions. Inflammatory bowel disease (IBD) and pain-related functional GI disorders (FGIDs) including functional abdominal pain disorders and irritable bowel syndrome (IBS) will be used as the primary examples due to the relatively larger literature base on these disorders compared to other GI conditions. Physiological mechanisms facilitating brain–gut interactions that impact disease presentation and patients’ functioning across diagnostic categories will be reviewed. Strategies for addressing implications of the brain–gut connection into psychological treatment also will be provided.

Brain–Gut Axis

The brain–gut axis refers to the bidirectional communications between the central nervous system (CNS), the autonomic nervous system (ANS), the hypothalamic-pituitary-adrenal (HPA) axis, and the gut. The gut is unique in being the only peripheral organ system with its own intrinsic nervous system referred to as the enteric nervous system. This system communicates with the CNS via the ANS and uses neurotransmitters in the gut such as serotonin and dopamine. The gut is also host to the gut microbiome, the diverse array of microbes and their genetic material, living in the gut (Foster & McVey Neufeld, 2013). All of these complex, overlapping systems play important roles in GI, immune, and emotional functioning, and multiple lines of research suggest that communication between any of these systems is bidirectional (Bonaz & Bernstein, 2013; Van Oudenhove et al., 2016). For example, GI symptoms may begin as the result of organic disease or hyperreactivity within the ANS. Alternatively or in conjunction with organic disease, anxiety and chronic activation of the stress response system may lead to alterations in the brain, spinal cord, and gut increasing risk for the onset of GI symptoms. Distress associated with GI symptoms may contribute to heightened anxiety and stress. With continued bidirectional symptoms over time, perception may be chronically altered (Mayer & Tillisch, 2011).

In considering the brain–gut axis as a cross-diagnostic explanatory model to understand difficulties experienced by youth with a host of GI disorders, this article will focus on the mechanisms of (a) alterations in pain processing, (b) the stress response system, and (c) gut microbiome activity. Levels of evidence vary with regard to the relative importance that these processes play, though it is recognized that these mechanisms affect patients across diagnostic boundaries and have profound impact on functioning and long-term outcomes.

Alterations in Pain Processing

Abdominal pain is a common symptom in pediatric gastroenterology patients and can occur in combination with an organic disease such as IBD or without clear underlying disease pathology (Berger, Gieteling, & Benninga, 2007). With regard to the brain–gut axis, pain represents a complex interaction of nerve signals, the spinal cord, brain structures, and alterations in pain processing at the visceral level of the intestines (Mayer & Tillisch, 2011).

Visceral hypersensitivity refers to heightened sensory perception in the context of the stomach and intestines, with no one pathway explaining its development (Camilleri, Coulie, & Tack, 2001). Sensations in the gut that are typically not perceived at a conscious level (e.g., digestion) can be noticeable to patients with visceral hypersensitivity and contribute to discomfort. Children with IBS and other FGIDs (e.g., functional abdominal pain) as well as children with inactive Crohn’s disease and ongoing abdominal pain exhibit lower visceral perception thresholds compared to healthy children, pro-
viding evidence for visceral hypersensitivity in these populations (Faure & Giguere, 2008). In adult populations, infections of the GI tract associated with acute inflammatory changes have been associated with increases in sensitivity for the relay of pain messages both at the site of tissue damage or inflammation and within the CNS (peripheral and central sensitization; Christianson et al., 2009). Heightened peripheral and central sensitization may remain after resolution of the infection, leading to ongoing visceral hypersensitivity (Mayer & Tillisch, 2011). Inflammatory disease processes in Crohn’s disease and ulcerative colitis can contribute to the development of visceral hypersensitivity and in some patients (estimations range from ~20% to over 50%) abdominal pain symptoms may persist despite remission of disease (Bielefeldt et al., 2009; Greenley, Kunz, Schurman, & Swanson, 2013).

The central nervous system modulates visceral pain signals through both ascending (i.e., transmission from the periphery to the cortex) and descending (i.e., modulation originating from the cortex) pain pathways (Staud, 2012). Both ascending and descending pain pathways can contribute to amplified pain signaling and characterize patients at greatest risk for ongoing chronic pain. Girls with pain-related FGIDs, compared to healthy controls, exhibit both heightened temporal summation of pain (i.e., an index of central sensitization of the nervous system) and diminished conditioned pain modulation (i.e., an inhibitory pain process generally thought to reflect the descending endogenous pain modulatory systems; Dengler-Crish, Bruehl, & Walker, 2011; Williams, Heitkemper, Self, Czyzewski, & Shulman, 2013). Thus, alterations in central pain processing may characterize children with pain-related FGIDs and contribute to ongoing GI symptoms and comorbid pain at other body sites (Walker, Dengler-Crish, Rippel, & Bruehl, 2010). Studies of patients with IBD have been inconclusive regarding alterations of central pain processing and presence of multiple chronic pains (Bielefeldt et al., 2009). Some, however, have reported an increased prevalence of fibromyalgia and noninflammatory joint pain, suggesting that alterations in central pain processing may be at play in IBD as well as in FGIDs (Buskila, Odes, Neumann, & Odes, 1999; Palm, Bernklev, Moum, & Gran, 2005).

The Stress Response System

The stress response system is made up of the HPA axis and the autonomic system of the brain–gut axis. The autonomic system, specifically its sympathetic branch, is responsible for the “fight or flight” response to stress, and the HPA axis provides the body’s longer-term stress reaction. The hypothalamus is considered to be the stress “control center” in the brain. Stress stimulates the hypothalamus, triggering the activation of the sympathetic nervous system, which quickly releases epinephrine to immediately deal with the stressor. If the threat continues to be perceived as stressful, the hypothalamus activates the pituitary and then adrenal glands, which release cortisol. Once the stressor passes, the parasympathetic nervous system takes over to dampen the stress response, which is often referred to as the “rest and digest” phase, because functions such as digestions are inhibited when the sympathetic nervous system is dominant. Thus, the sympathetic nervous system initiates communication with the enteric nervous system in the gut which regulates various functions in the GI tract. These include intestinal motility, secretion, and intestinal permeability and represent direct mechanisms by which stressors can impact GI functions (Furness, 2012; Mayer, Labus, Tillisch, Cole, & Baldi, 2015).

The effects of stress on the immune and inflammatory system are complex. Yet, the duration and intensity of stressors are known to play a large role in this process and both animal and human studies suggest that stress is particularly key in the pathogenesis of GI disorders. For example, it has been shown that sustained stress over time causes prolonged increases in cortisol that is often associated with immunosuppression as well as increases in inflammatory markers. Experimental studies have shown also that acute stress stimulates the sympathetic nervous system, resulting in increases in cortisol and the production of inflammatory cytokines that are implicated in GI disorders (Hueston & Deak, 2014; Mawdsley & Rampton, 2005). In IBD specifically, stress may initiate or reactivate GI inflammation leading to worsening symptoms, and GI tract motility can be affected by the impact of stress on the enteric nervous system, hence contributing to abdominal pain and
changes in bowel function (Bonaz & Bernstein, 2013).

**Gut Microbiome**

The gut microbiome, or the intraintestinal environment component of the brain–gut axis, impacts a host of physiological functions and conditions. It is composed of thousands of different microbial species and more than 15,000 kinds of bacteria that are thought to stabilize between 6 and 36 months of life. The microbiome is responsible for the maturation of the immune system, the synthesis and metabolism of certain nutrients, hormones, and vitamins, and clearing the body of drugs and toxins (Mangiola et al., 2016).

The mechanisms by which the microbial environment impacts GI specific functions are as complex as the microbiome itself. Intestinal microbiota can affect brain (CNS) function and the host organism’s behavior via several mechanisms including endocrine and neuroendocrine pathways; in turn, the brain can alter microbial composition presumably through the autonomic nervous system (Ringel & Ringel-Kulka, 2015). To reiterate, these influences are not unidirectional, but rather bidirectional such that the CNS is able to change the composition of the gut microbiota, thereby altering gut permeability, motility, visceral sensation, inflammation, and secretion through activation of the HPA, and autonomic and neuroendocrine systems, with an immediate and corresponding effect on the gut microbiota (Mangiola et al., 2016).

Stress in early life, a specific form of CNS activation, also initiates HPA function and, in turn, impacts the developing microbiota and vice versa. These alterations ultimately lead to maladaptive changes in the delicate balance of intraintestinal microorganisms (dybiosis) and an inappropriate stress response (O’Mahony, Stilling, Dinan, & Cryan, 2015).

A change or imbalance in the intestinal microbiota has been increasingly linked to GI disease/dysfunction, as well as other conditions. As an example, children with IBS evidence greater γ-Proteobacteria compared to healthy controls and a greater occurrence of abdominal pain correlated with an increased abundance of several bacterial taxa from the genus Alistipes (Saulnier et al., 2011). There also have been differences found in the gut microbiota between healthy control and IBD patients (Cucchiara, Iebba, Conte, & Schippa, 2009) and children with diarrhea-predominant IBS (Rigsbee et al., 2012). Studies have shown that the fecal microbiota diversity is reduced in Crohn’s disease (CD) patients, with reductions in the number of certain bacteria, and an increased number of E. coli compared with healthy children (Aomatsu et al., 2012; Schwertz et al., 2010). Changes were not as dramatic in ulcerative colitis (UC) patients. With increasing severity of UC, however, the changes in gut microbiota are more evident with lower microbial diversity, overall, and specific reduction in clostridia, and increase in γ-Proteobacteria, compared with healthy children (Michail et al., 2012).

Importantly, although IBD and IBS are classically viewed as distinct conditions, with the former being an organic disease and the latter a disorder of gut function complicated, or even driven by psychological factors, recent research has identified some shared epidemiologic, genetic, immune, and microbiological contributing factors (Barbara, Cremon, & Stanghellini, 2014). Most widely accepted is that acute, infectious gastroenteritis has been linked to the onset of both IBS and IBD. Less definitive, preliminary data suggest that IBS, similar to IBD, is linked to an abnormal immune response to luminal microbiota in genetically predisposed individuals (Barbara et al., 2014). Disruption to the microbiota in early life also has been implicated in celiac disease pathogenesis (Decker et al., 2010).

**Maintenance Factors**

Psychological and contextual factors interact with the above described biological factors to maintain or contribute to the resolution of clinical symptoms in pediatric GI disorders. Many of these maintenance factors represent targets for psychosocial interventions and cut across diagnostic groups. The brain–gut axis highlights the role of psychological factors such as anxiety, depression, or stress reactivity in influencing symptom perception through modulation of pain, inflammation, and the gut microbiome. Contextual factors can also modulate symptom perception through contributing to psychological factors and activating stress response systems.
Psychological Factors

Regardless of underlying disease pathology, the diagnosis and ongoing management of painful and/or embarrassing symptoms can be emotionally, physically, and socially taxing, thereby placing youth with GI disorders at risk for more psychosocial difficulties (e.g., symptoms of depression, anxiety, and poor body image in addition to social withdrawal or teasing from peers). Both youth with functional abdominal pain and youth with IBD exhibit increased risk for depressive symptoms relative to healthy peers (Korterink, Diederen, Benninga, & Tabbers, 2015; Mackner et al., 2013). Directionality of the onset and maintenance of depressive symptoms in patients with GI disorders is a topic of active research. Anxious and depressive symptoms can influence the onset of GI symptoms (e.g., “butterflies in the stomach”). Alternatively, depressive symptoms also may occur as a result of disease processes within the GI tract (e.g., changes in the microbiome; Foster & McVey Neufeld, 2013) or as a result of practical difficulties in adjusting to GI symptoms. Depressive symptoms can contribute to the maintenance of GI conditions through influencing health behaviors (e.g., adherence to medical treatment) and physiological systems (e.g., dysregulation of the HPA axis; Miller, Maletic, & Raison, 2009).

Cognitions and emotional states including, but not limited to depression, can contribute to the interpretation of and maintenance of symptoms, especially pain, in patients with GI disorders (Biefeleldt et al., 2009; Mayer & Tillisch, 2011). Brain regions associated with affective experiences (e.g., anterior cingulate cortex, insula, and amygdala) interact with the sensory input to influence symptom perception in patients with IBS (Tillisch, Mayer, & Labus, 2011). Anxiety, heightened fear of GI symptoms, hypervigilance, and pain catastrophizing have been associated with greater symptom severity in individuals with IBS (Kennedy et al., 2012). There is some evidence that both anxiety and GI symptom severity are associated with brain regions commonly activated in response to fear (Drossman, 2005; Van Oudenhove et al., 2016). Cognitive therapy for IBS in adults has been shown to reduce limbic system activation in the brain, which was coupled with improvements in GI symptom severity and anxiety (Lackner et al., 2006).

Contextual Factors

The brain–gut axis operates within the broader context of one’s environment which also can influence the presentation of GI symptoms. Environmental and social stressors can contribute to both the onset and maintenance of GI disorders through influencing HPA axis regulation, immune functioning, and sympathetic nervous system activation. Stressors contributing to chronic activation of the stress response system (e.g., trauma, poverty, peer victimization) are important to assess and consider (Hansel, Hong, Camara, & von Kanel, 2010). Although psychologists often cannot intervene directly on chronic stressors, helping youth cope in effective ways may have important implications for improving physical and emotional health (Lovato, 2015).

Parents represent one of the most important contextual factors influencing the maintenance of children’s GI symptoms. Children can learn adaptive or maladaptive illness-related behaviors from their parents (Levy, Whitehead, Von Korff, & Feld, 2000). For example, adolescents with functional abdominal pain who observed more frequent pain behaviors in their parents (e.g., grimacing, moving slowly) were more likely to experience greater pain and pain interference (Stone & Walker, 2016). Some parents reinforce maladaptive illness behaviors through solicitous or protective responding to children’s pain complaints (Walker et al., 2006). Encouragingly, evidence suggests that cognitive–behavioral therapy targeting parental responses to pain and children’s coping is effective at reducing pain and GI symptoms (Levy et al., 2010).

Implications for Clinical Care

Case Conceptualization

Psychology providers’ and families’ understanding of the brain–gut axis and the associated physiological and psychological mechanisms of change in symptoms and distress has the potential to improve pediatric GI patient care. Incorporating education on the brain–gut axis into the initial evaluation appointment with
the psychologist serves as a vital foundation for the ongoing care of the pediatric GI patient and his or her family. This type of ongoing education also can clarify the role of the psychologist as a vital and nonthreatening part of the medical team who will be available to help patients discover strategies for reducing symptoms by impacting the brain–gut axis through behavioral strategies (Crushell et al., 2003). By acknowledging the brain–gut axis, including mechanisms actively being researched like the gut-microbiome, psychologists build trust and can help patients gain an understanding of symptoms that, at times, may seem inexplicable. Though evidence-based treatment recommendations for directly impacting mechanisms of the brain–gut axis are limited, psychologists, by incorporating education on known mechanisms, can gain credibility for promoting behavioral strategies with demonstrated effectiveness for impacting maintenance factors, symptoms, and long-term outcomes including daily functioning.

Figure 1 has been provided as a base for guiding these discussions with patients and families. The model was intentionally designed so that it can be customized to meet an individual patient’s needs and to be actively used in session to provide education and to begin psychosocial treatment planning. Younger children may be encouraged to color the areas of Figure 1 affected by GI symptoms and to use a recent symptom episode to guide the identification of thoughts and feelings. Older children and adolescents may simply mark the areas of distress and require less guidance but should still be encouraged to write typical feelings and thoughts related to symptoms. Clinicians can guide children of all ages in identifying biological (e.g., having eaten a large meal, poor sleep, practicing deep breathing), psychological (e.g., worrying about a test, expecting to feel pain),
and social (e.g., moving schools, busy schedule) factors that either seem to exacerbate or lessen GI symptoms. (See Appendix for sample clinician scripts to accompany Figure 1).

**Building a Relationship for Treatment**

In his or her role, a psychologist can serve as a critical resource in conveying to collaborating medical team members the most productive tone for interactions with pediatric patients and their families. Though originally proposed for cases of somatization (indeed, quite different from the aforementioned GI diagnoses discussed), Campo and Fritz (2001) provide a succinct set of guidelines that can be helpful to medical and psychological team members in assessing and managing children with chronic GI complaints, including abdominal pain. These principles include (a) being honest and reassuring; (b) acknowledging the child’s suffering and the concerns of the family; (c) not dismissing symptoms as subjective, conveying the symptoms as fabricated, or stating that nothing is wrong; (d) exploring the timing, context, and characteristics of symptoms; (e) identifying previous assessments/treatments; (f) detecting situations or factors that affect symptoms; and (g) soliciting information from multiple sources. Di Lorenzo et al. (2005) also proposed that including as part of early discussions with families reassuring messages that the child’s pain is understood, that it is not dangerous, and that there is something that can be done about it—can be very helpful in decreasing anxiety and further health care seeking in both the parent and child.

**Biopsychosocial Assessment**

Consistent with providing families with a biopsychosocial conceptualization of their child’s GI condition is the offering of a comprehensive assessment of his or her presenting concerns that, in particular, gives ample attention to the biological or physical complaints that initiated consultation with a GI specialist. Beginning the evaluation with a thorough assessment of problematic physical symptoms (e.g., nausea, vomiting, pain, and/or stool changes) can help alleviate families’ preconceived notions about the nature of meeting with a psychologist, as well as potentially increase “buy in” and engagement from families who have come to clinic expressly to address physical symptoms.

Identification of psychosocial factors that may be contributing to or maintaining symptoms, and that may be appropriate targets of treatment, also is pivotal as part of the initial clinical workup. To that end, brief self- and/or parent-report measure can be employed within a busy clinical setting to quickly screen for areas of concern and prioritize treatments as part of the initial clinical approach. Many validated questionnaires (See Maddux, Deacy, & Lukens, 2014, for a review of GI relevant psychosocial assessment measures) are available to assess issues common in children with chronic GI illnesses, including behavioral and emotional concerns, early trauma or ongoing developmental issues, parent behavior, quality of life, sleep, and functional disability, among others. In addition, relevant information about school (e.g., attendance, perceived barriers, learning history) may be elicited quickly via a few targeted questions posed during the medical history (Schurman, Deacy, & Friesen, 2013). Identification of alleviating factors, as well, can assist in determining the patient’s current coping repertoire as well as his or her sense of control and competence with managing symptoms.

**Psychological Intervention**

Setting the stage via provision of a biopsychosocial conceptualization of pediatric GI conditions and administration of a thorough, comprehensive health assessment provides an ideal context for a multicomponent approach to treatment. Indeed, there is some evidence that children whose parents accept a biopsychosocial conceptualization of abdominal pain and its treatment are more likely to experience symptom improvement (Scholl & Allen, 2007).

**Parent-Focused**

Parental education and skills training is often a critical component of the care of patients with chronic GI conditions. Parents can be coached to maintain behavioral expectations for their child’s participation in school and other activities and taught to model and encourage active coping with pain symptoms (e.g., use of deep breathing, distraction, relaxation, and positive...
thinking during pain or other symptom episodes and/or before identified triggering events such as eating or taking a test at school; Scholl & Allen, 2007). In this context, parents can be coached to decrease the amount of attention paid to repetitive symptom complaints and non-verbal pain behaviors, while simultaneously providing attention and praise (or other rewards) for their children’s well behaviors and their demonstration of adaptive coping (e.g., using relaxation, attending a portion of the school day, participating in a previously avoided social activity; Crushell et al., 2003). Parents also should be reassured that it is okay, and even preferable, not to regularly ask about their child’s pain, as pain tends to worsen when children attend to it and improves when they are distracted from it (Schurman et al., 2013).

Child-Focused Psychotherapy

Cognitive–behavioral therapy, gut-focused hypnotherapy, and biofeedback-assisted relaxation training (Brent, Lobato, & LeLeiko, 2009) currently have the most, albeit still limited, empirical support among the child-focused interventions available for children with chronic GI conditions, and abdominal pain, in particular. All three services, in some form, focus on changing patients’ thoughts and/or behaviors in the interest of alleviating physical symptoms, as well as mitigating collateral symptoms of anxiety, depression, and the like that may have predated or developed subsequently to the diagnosis of the chronic GI condition. Understandably, psychological issues can be a significant source of emotional and social stress that may play a further contributory role in maintenance of pain and disability (Schurman et al., 2013).

School Intervention

Because many children with chronic GI conditions have school problems (e.g., they miss school for days, or even weeks, because of symptoms, doctors’ visits, or hospitalizations, get behind in daily schoolwork, have a hard time paying attention in class, suffer social embarrassment related to frequent trips to the restroom, and/or feel overwhelmed by makeup work), psychologists can play a key role in the development of appropriate academic accommodations. Examples of accommodations that can be helpful in supporting patients’ regular attendance and success at school include allowing easy access to the bathroom, encouraging brief breaks for use of stress and pain management skills, allowing participation in clubs and sports while working on getting back to school, and carefully considering makeup work and the timeline for its completion (Schurman et al., 2013). When children have been out of school for a long period of time due to their abdominal pain and/or other physical symptoms, a gradual and structured return to the classroom also may be an important part of the treatment plan. Approaching return to school in this fashion has the advantage of reducing patients’ fear and avoidance, while reintegrating patients into age-appropriate academic/social activities and redirecting attention from symptoms toward functioning (Baldwin Gracey & Ward, 2012; Walker, Beck, & Anderson, 2009). Although variations on a graduated approach to school reentry exist, three key steps include (a) choosing a block of time the patient is able to attend every day without increased symptoms; (b) the patient attending school for the agreed upon amount of time (no more, no less), regardless of pain; and (c) regularly evaluating the patient’s progress to determine when and how much additional class time to add to his or her schedule. In some cases, psychologists can provide guidance to families on initiating a formalized plan that summarizes some or all of the above recommendations (e.g., a Section 504 Plan in the United States or an Education, Health and Care Plan in the United Kingdom) to encourage consistent implementation of accommodations by all school staff.

Future Directions

To ensure competency in delivering biopsychosocial care as described above, graduate level training and continuing education that explicitly addresses biopsychosocial models of care for pediatric GI disorders is essential. As an example of continuing education efforts, in the past few years, psychologists in the Pediatric Gastroenterology Special Interest Group (PG-SIG) of the Society of Pediatric Psychology have become increasingly active in the once physician-dominated organization of the North American Society of Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN). This has resulted in psychologists becoming
increasingly recognized by their GI physician colleagues for their expertise in the psychological aspects of pediatric GI disorders. Psychologists within the PG-SIG and others have been invited in recent years to present both clinical and research findings relevant to the multidisciplinary care of pediatric patients with a range of GI disorders at NASPGHAN Annual Meetings, and involvement continues to grow.

To further promote and maintain cross-discipline collaborations, pediatric psychologists are called upon to engage in research aimed at identifying the most effective strategies for incorporating discussion of brain–gut interaction into routine clinical care, improving access to multidisciplinary treatment for pediatric GI patients, and identifying biopsychosocial interventions most likely to improve the quality of life of children and adolescents affected by GI conditions. In addition, continued development of training opportunities focused on GI populations is necessary at all levels, from practicum, internship, and postdoctoral placements to continuing education for licensed psychologists. Pediatric psychologists in academic medical center settings may also seek out opportunities to engage in training of medical students and GI fellows to demonstrate the incorporation of biopsychosocial principles as a basic tenet of holistic training.

Conclusions

Research on brain–gut interactions is advancing daily, especially in the areas of the gut microbiome (Van Oudenhove et al., 2016) and psychoneuroimmunology, which describes linkages between immune functioning, psychological processes, and the nervous system (O’Connor, Moynihan, & Caserta, 2014). Pediatric psychologists beginning specialized work with GI patients or who encounter patients with GI complaints in primary care, consult-liaison work, or independent practice are encouraged to incorporate discussion of brain–gut interactions into their clinical case conceptualizations and individualized treatment plans. Treatment planning based on a conceptual framework that accounts for brain–gut interactions sets the stage for multidisciplinary care of pediatric GI conditions. A multidisciplinary treatment approach which takes into account interactions between biological and psychological processes, as well as distinct contributors to presenting symptoms, is also most likely to be effective and well received. By beginning treatment based on the biopsychosocial model, patients with GI disorders and their families will be equipped from the beginning with the foundation necessary for successful delivery of and adherence to psychological intervention.

References


BRAIN–GUT PEDIATRIC GASTROENTEROLOGY


Appendix

**Clinic Scripts to Accompany “My Brain-Gut Axis” Handout**

Figure 1 can be used as a visual aid to describe the Brain-Gut Axis and how biopsychosocial factors can serve as maintenance factors. Figure 1 was designed to be generic and to allow for patients to write in their individual situations so that it can be adapted for use with different patient populations. Clinicians are encouraged to use the descriptions provided below to guide an explanation of the Brain-Gut Axis. Incorporating specific patient information, derived from the interview, will best help the patient and parent see how the model applies to their situation and which biopsychosocial factors are most at play.

**A. Brain-Gut Axis**

Understanding how your mind and body are connected can help you learn new ways of managing your gastrointestinal symptoms through your thinking patterns, how you take care of your body, and how you manage stress. Our bodies are designed to react differently when we feel stressed versus relaxed. We call the link between our mind and our gastrointestinal system the Brain-Gut Axis. Let me tell you more about how this works.

When we get stressed, our brain tells our body to go into “fight or flight” or “stress mode” to help protect us. Let’s pretend we’re getting chased by a bear. Our brain tells our heart to beat faster, our breathing to accelerate, and our muscles to tense so that we can better fight or run from the bear. Our body also “shuts down” parts that won’t help us survive the bear attack such as our digestion. Because it takes too much time and energy to process our food when we’re threatened, our brain also shuts down our GI system and instead uses the energy that it’s already stored up. When we slow down digestion and stop paying attention to our GI system, the food can move through more slowly and this can cause fullness, cramps, or constipation. Or sometimes it can move through too fast (i.e., diarrhea) or even travel in reverse (i.e., vomiting) to get rid of any extra weight if you’re trying to out-run that bear. Every year, scientists learn new ways that the brain and the gut interact, including through the stress response system as we discussed as well as through the bacteria that live in our gut and how the nerves in our GI tract respond to and transmit pain signals. Sayings such as “I have butterflies in my stomach” highlight how common it is for people to have GI reactions in response to how they are feeling or what they are thinking.

(Appendix continues)
When our GI system isn’t working as we would like, such as when we have pain, constipation, or diarrhea, it can definitely make us (and our body) feel even more stressed. So we can get stuck in a terrible loop where the more stressed out your GI system is (i.e., diarrhea, pain, etc.), the most stressed out you get (e.g., embarrassed, anxious, frustrated).

B. Biopsychosocial Model

When kids and teenagers have GI symptoms, there is rarely one, single thing that causes symptoms, but rather a number of factors that can contribute to symptoms, their severity, and how long they last. We talked about the Brain-Gut Axis and how feeling stressed versus relaxed can affect our GI symptoms. Knowing that, let’s think about the different ways we can affect how stressed we feel to break any unhelpful parts of this stress-GI symptoms loop. We refer to this as a biopsychosocial approach, meaning that working with your doctors, we will consider all ways to help you feel better, from the biology and physiology of the gut to the psychological and social factors that may be important to understanding the problem and treating it.

Let’s think about abdominal pain as an example. Biological factors that we consider include whether there are any signs of inflammation, whether digestion is occurring as it should, and how the nerves involved in sensing and relaying pain signals seem to be working.

Psychological factors such as worry and anxiety, poor sleep quality, and feeling down or frustrated can be expected responses to having GI symptoms, but can also contribute to you feeling worse. Social factors, such as missing school and getting out of normal routines at home and with friends can affect how you feel in your mind and body and also are important for us to talk about. All of these factors, though they don’t, on their own, cause your abdominal pain, play a key role in potentially worsening, or often, maintaining symptoms once they start.

The good news is that by understanding how all of these systems work together, we can design a treatment based on a combination of these factors to help you feel better.

Psychological factors such as worry and anxiety, poor sleep quality, and feeling down or frustrated can be expected responses to having GI symptoms, but can also contribute to you feeling worse. Social factors, such as missing school and getting out of normal routines at home and with friends can affect how you feel in your mind and body and also are important for us to talk about. All of these factors, though they don’t, on their own, cause your abdominal pain, play a key role in potentially worsening, or often, maintaining symptoms once they start.

The good news is that by understanding how all of these systems work together, we can design a treatment based on a combination of these factors to help you feel better.

C. The role of Psychology

My job, as the psychologist, is first to understand how your GI symptoms are impacting your life and family. Next, we will work together to find new ways of managing your symptoms, and I will show you strategies that have worked for other kids including different ways of managing stress and difficult emotions. Your parents may be asked to make changes too. We will discuss how their responses can be most helpful for reducing your symptoms and getting you back into your normal activities so that you can focus on being happy and healthy and doing the things that you enjoy. Together, we will help you find ways to break the loop of stress and GI symptoms.

Using Figure 1 as a guide, clinicians are encouraged to work with patients to follow the prompts to identify how the Brain-Gut Axis applies to their symptoms as well as individualized factors that are working to potentially maintain distress.