18 Functional Gastrointestinal Conditions in Children and Adolescents (Gut–Brain Interaction Disturbances)

Kenia L. Gomez and Jessica DiCarlo

Introduction

Like other organ systems, the digestive system, starting at the mouth and ending at the anus, is a very long system; it is also the setting in which a number of emotional and behavioral difficulties can be expressed.

Of course, this system's primary function is to maintain the supply of energetic material for the subject to survive, grow, and function. The individual must continue to ingest necessary food and eliminate the residues in some way. It is a very long system in terms of its sheer measurements. It is also richly innervated by the sympathetic and parasympathetic nervous systems which make it very responsive to the emotional life of the child.

The digestive system additionally contains multiple symbolic mental representations associated with the intake and digestion of food, nutrition, and growth of the body, as well as the elimination of waste.

Sigmund Freud placed great emphasis on the oral phase of the development of the child as an erogenous zone with primal importance in the infant. Then, Freud and many other psychoanalysts assigned great importance to the control of the anal sphincter around the second birthday. The ability to control defecation represents control of oneself as the child eliminates feces in acceptable places. Often, conflict arises between parents and children around issues of cleanliness; therefore, management of aggression, social acceptability, and socialization are associated with the tension between retaining versus releasing feces. To the dismay of parents, feces, like food, can be used by the child as a "weapon" to express anger and disgust.

All cultures invest foods with very important symbolic meanings. Food is the subject of various taboos, such as ingesting certain meats (e.g., the ban on pork in Islam and Judaism and on beef in Hinduism). Certain foods can or cannot be mixed; they "should" be ingested cold, hot, or cooked in specific prescribed ways. Food and its consumption are also invested with individual meanings, depending on the experience of each child. In addition, practices of feeding children vary across cultures, from force-feeding certain foods to the young child, to vegetarianism, to eating only organic foods, on the rule-bound end of the spectrum, to a very permissive attitude in which children may be allowed to eat what they like, alone or in a communal feeding (family or group meal).

K. L. Gomez (✉)
Department of Pediatric Newborn Medicine, Brigham and Women Hospital/Massachusetts General Brigham, Boston, MA, USA
e-mail: kgomez7@bwh.harvard.edu

J. DiCarlo
Psychiatry and Behavioral Sciences, The University of Texas Health Science Center at Houston (UTHealth), Houston, TX, USA
e-mail: Jessica.dicarlo@uth.tmc.edu

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

J. M. Maldonado-Duran et al. (eds.), *Handbook of Mind-Body Integration in Child and Adolescent Development*, https://doi.org/10.1007/978-3-031-18377-5_18

The functioning of the gastrointestinal system of their son or daughter is of great interest to parents, such as whether the child exhibits adequate appetite, ingests the food, digests it properly, and then eliminates regularly and in the right place. Many vicissitudes can occur in these situations. Food, digestion, and feces have multiple individual and cultural representations which will be reflected in the sorts of conditions described here.

In this chapter, we focus on a number of conditions that worry parents, cause suffering to the child, and can have a powerful impact on the quality of life of the subject and those surrounding him or her. We will predominantly describe situations in which the child has symptoms of gastrointestinal dysfunction but no biochemical or anatomical evidence of any known disease (Benninga et al., 2016). These conditions are strongly related to emotional, behavioral, maturational, and interpersonal factors in the life of the child or adolescent.

Background

The gastrointestinal system is a richly innervated part of the organism. The normal function of the gastrointestinal apparatus (from one end to the other) requires the coordination of multiple factors, starting with the availability of nutrients, which cannot be guaranteed in our modern world to everyone. For optimal growth in children and adolescents, an adequate intake of calories, protein, fat, as well as vitamins, minerals, and micronutrients is required. These elements must be available, and in an ample number of sectors around the world, they are not, due to poverty, famine, and other causes.

Another factor in the intake of food is appetite, or a hunger signal, which determines the desire to eat and the child's interest in food. Which items are considered edible is an issue strongly influenced by the environment and by culture; there is much diversity in approach among human cultures to various insects, fishes, crustaceans, etc., as well as to a whole variety of vegetables cooked in a myriad of ways. With rapid globalization since the Industrial Revolution, in many urban areas, there is more availability of different cuisines; children may be exposed to a greater variety of tastes and styles than was the case for the hundreds of thousands of preceding years during which *Homo sapiens* and our ancestors were relatively separated by culture.

After appetite (the desire for specific foods) and hunger (the need to eat), comes the capacity to ingest food, contain food inside the body, and then to digest it. First, it is processed in the mouth, then it is swallowed. All of these functions can be altered due to multiple mechanical, physiological, and psychological factors. The same can be said about the processing of the food in the stomach and then in the small intestine, and eventually, the large intestine. Then, there must be a process of elimination. All these functions can be slowed, accelerated, or altered in some way. Of course, this is a cyclical process that occurs several times per day in some of its phases.

The gastrointestinal system is enriched with much innervation and neurotransmitters resembling those of the central nervous system. It is therefore highly sensitive to psychosocial factors, such as tensions, anxieties and worry, or stress in general, as well as anger. Increasingly, there is an awareness that the sensitivity of the gastrointestinal system to emotional experiences is determined in part by innervation and neurotransmitters, which determine motility (Noejovich et al., 2020), rather than purely by quality and quantity of what is ingested (Faure et al., 2017).

The central nervous system impacts the digestive system through the autonomous nervous system (sympathetic and parasympathetic systems) and the hypothalamic-pituitary-adrenal (HPA) axis, which influence intestinal motility (Mayer et al., 2008), secretion of fluids in the gut, and immune function (Elenkov & Chrousos, 2006). These factors affect the combination of microbes which perennially inhabit the gut. Of interest to us in this chapter, Kerr et al. (2014) proposed that early negative life events can also alter the "consortium" of bacteria in the digestive system, diminishing the resilience of the microflora, and thus can change the metabolic function of the individual.

What Are Functional Gastrointestinal Conditions?

The "Rome Criteria" for functional gastrointestinal disorders is an enumeration of conditions which a group of international experts periodically reviews and updates. The group initially convened in Rome under professor Aldo Torsoli (Drossman et al., 1990; Schmulson & Drossman, 2017). There have now been several revisions. In the latest one, to the long list of names for "functional disorders," a new one is proposed: "disorders of gut–brain interaction." The general idea is similar to unexplained gastrointestinal symptoms, functional symptoms, somatoform conditions, or "somatic symptom disorder" as referred to in the DSM V. Of note, there are other consensus groups— the main ones are the Lyon consensus group and the Montreal consensus group— which have also addressed several gastrointestinal conditions from different perspectives (Katzka et al., 2020).

The term Rome Criteria for gut–brain interaction refers to disorders that are commonly seen in clinical practice, manifest in the form of gastrointestinal symptoms, have no known relation to structural or other biological, "organic" damage, but still do affect the function of the system. Currently, the Rome IV Criteria (Drossman & Hasler, 2016; Schmulson & Drossman, 2017. Sood & Ford, 2016) depict nine main conditions in children and adolescents. This system, based also on symptoms (like The Diagnostic and Statistical Manual for Mental Disorders), has been criticized (Sood & Ford) as excessively complicated and not of great use for the clinician in actual practice. In the "real clinical world," clinicians often do not make the minuscule distinctions recommended by the classification; physicians diagnose and treat the patient in their uniqueness, as each patient is different from others in many particulars. Based on the criteria alone, patients may even have several conditions, or they may have a disease based on known organic abnormalities, but with superimposed functional symptoms. These disturbances are divided according to regions of the gastrointestinal system: esophageal, gastroduodenal, intestinal, biliary tract, and the anorectal area. Clearly, one same child can have two or more of these conditions.

An important aspect of the new criteria for "gut–brain interaction" disturbances is the issue of multiculturalism and transcultural aspects of distress. Different languages describe symptoms of anxiety and "nerves" in different ways. Some phrases clearly reflect the feeling of distress in the gastrointestinal system. "That makes me sick" describes nausea or disgust. "Butterflies in the stomach" depicts anxiety— an expression used in the English language. A "punch in the stomach" refers to a shocking, unpleasant surprise. There are more obscene expressions to refer to the notion of defecating due to being frightened or surprised. Other languages have similar and different expressions. In Spanish, people talk about having a "hole in the stomach" when they feel worried or anxious or of having "a lot of bile" when they are angry. Clearly, patients in different cultures in non-Westernized countries attribute gastrointestinal symptoms to "something they ate" which was not adequate. The way people refer to their symptoms is related to different cultural representations.

The Rome IV criteria include conditions that are not strictly functional, like opioid-induced gastrointestinal hyperalgesia, opioid-induced constipation, and cannabinoid hyperemesis. Of these drug-related conditions, only the latter is reviewed here, as it is likely to be seen in adolescents who consume marijuana routinely.

These disorders are not rare at all, particularly in the young infant and toddlers, but continue to be quite frequent in school-age children and adolescents. In a recent survey in the United States, 1255 mothers of children were interviewed (Robin et al., 2018); it was estimated that based on the Rome IV criteria, 24% of infants and toddlers from zero to three years of age, and 25% of all children in the preschool, school, and adolescent years have a functional gastrointestinal disorder. Regurgitation is the most frequent gastrointestinal problem in infants (around 24%) and functional constipation is the most prevalent in both toddlers (18%) and children and adolescents (14%). Similar rates have been reported in other

surveys in El Salvador (Zablah et al., 2015) and in Colombia (Saps et al., 2014). Studies reveal a higher prevalence in girls than in boys. An internet survey in the United States (Lewis et al., 2016) of around 25% of all children from preschool age to adolescence found similar rates of functional gastrointestinal disorders.

In a majority of children with recurrent abdominal pain, no "physical" cause can be found (Devanarayana et al., 2008).

When these conditions are severe, they may lead to hospitalization or repeated hospitalizations. The main reason for hospitalization in all minors is abdominal pain and constipation. In the group of children 5 to 9 years of age, the most common problems are constipation and fecal incontinence (Park et al., 2015).

Some of the conditions can hardly be considered a "disorder," as they tend to be extremely prevalent in infants, for example, regurgitation and colic (Benninga et al., 2016). These troubles are often worrisome to parents, but the issues tend to run their course as the infant's body becomes more coordinated as she or he develops.

Here, we are not going to discuss all of the numerous conditions within the gastrointestinal system that different consensus groups have described, but we will focus on the problems most commonly found in clinical practice in children and adolescents. We focus not so much on the criteria, but on the mind–body interaction issues and on the management strategies that apply.

Cyclic Vomiting Syndrome

Cyclic vomiting syndrome (CVS) is an often undiagnosed condition in children and adolescents; it is very complex in its etiology, although fairly typical in its clinical presentation. It can only be diagnosed after other causes for vomiting have been ruled out. CVS occurs more frequently in children than in adults.

The current Rome Criteria for CVS are as follows: (1) a history of two or more periods of intense, unremitting nausea and paroxysmal vomiting, lasting hours to days within a six-month period, (2) episodes are stereotypical in each patient, (3) episodes are separated by weeks to months with return to baseline health between episodes, and (4) after appropriate medical evaluation, the symptoms cannot be attributed to another condition.

CVS generally begins in the preschool age and affects 1–3% of children (McOmber & Shulman, 2008). In a series of 181 consecutive cases in Shiraz, Iran (Haghighat et al., 2007), most cases started around five years of age. The mean lapse between the onset of the vomiting and its diagnosis as cyclic vomiting was around two years. A few patients had episodes since early infancy. Also, almost half the children had antecedents of motion sickness (or high sensitivity to movement in space leading to nausea) and more than half (58%) of the children had vomiting episodes that included headache. Other associated symptoms are excessive salivation and abdominal pain. The frequency of vomiting varies but is typically consistent among episodes for each child. The frequency can peak at six times per hour (Li, 2001).

Cyclic vomiting syndrome can have a familial determinant (Haan et al., 2002), as well as a genetic marker in some cases (a mitochondrial DNA alteration). It is often associated with migraines, which has led to the conclusion that this type of vomiting is a form of "migraine," and should be treated and prevented as such. However, it has not been demonstrated in any way that CVS is indeed a form of migraine (Haghighat et al., 2007). There are often psychosocial factors associated with cyclic vomiting, as tension and high levels of emotional stress (Keller et al., 2013) often precipitate the episodes.

> *Stephanie, a 17-year-old girl with no past medical history, presented three times within six months to the emergency room with unremitting vomiting. Several diagnostic studies, including an endoscopy, were performed, with negative results. While hospitalized, Stephanie was forthcoming that she occasionally smokes marijuana, but has not had access to it lately. It was discovered during her hospitalization that Stephanie was experiencing significant conflict over growing older and soon leaving for college. She was surprised to find herself in tears over her parents' divorce from several years ago, and the effects of her parentification in her being*

asked to emotionally support her mom and her younger sister. All the while, she felt "not good enough." She also commonly experienced symptoms of anxiety including fear of the worst happening, being unable to relax, feeling unsteady or shaky, heart racing, difficulty breathing, and hot spells. To address her anxiety, fluoxetine was initiated. Since therapeutic effects of this medication take a few weeks and she required immediate relief of her vomiting in the hospital, propranolol was also initiated. Within four days, as was typical for Stephanie's previous two episodes, her vomiting had stopped and she felt like herself again. Maintenance intravenous fluids were discontinued and the next day, she was discharged home with close psychiatric follow-up to continue to address her worries in a more in-depth psychodynamic manner.

Differential Diagnosis

It is necessary to distinguish an acute from a chronic presentation. If the patient has a short history of episodes of vomiting, it is important to rule out metabolic causes, as well as disorders in the gastrointestinal tract which may require surgical interventions, such as volvulus, intestinal obstruction, and the like. When the course is chronic, the physician must balance conducting a number of important tests to rule out organic causes versus avoiding unnecessary studies which are not going to be of use in terms of the treatment or outcome of the vomiting.

Although the episodes are self-limiting, supportive measures may be necessary to prevent dehydration and electrolyte imbalance. Frequent vomiting can lead to metabolic complications. Many children have multiple visits to an emergency room and initially, many are first diagnosed with food poisoning, peptic ulcer disease, or a metabolic disorder in the absence of any endoscopic findings explaining the condition.

Psychological Manifestations and Treatment

Generally, for cyclic vomiting, physicians recommend to avoid meals with high protein content, avoid fasting, and to diminish the level of stress of the child.

Medications like cyproheptadine in children younger than 5 years of age and amitriptyline in children older than 5 years of age are often recommended. Moreover, prophylaxis with propranolol for children of all ages can be tried (Hyams et al., 2016). Topiramate and valproic acid can also be used preventively. Several trials suggest that all of these can be effective. In addition to the preventative treatment of vomiting, these medications have psychotropic properties that may promote mood regulation and alleviation of distress. Some children may require a combination of medication and cognitive-behavioral therapy (Slutsker et al., 2010) or psychodynamic psychotherapy to help control their symptoms. If a multidisciplinary evaluation suggests that there are important tensions in the child, family difficulties, problems in the preschool or school setting, these stresses could be addressed as a way to deal with the problem thoroughly. For example, if the child is very anxious, sensitive, and emotionally fragile, cognitive or behavioral strategies may be useful to help reduce his or her anxiety. Family therapy may be helpful if the home atmosphere contains tension and conflict.

Cannabinoid Hyperemesis Syndrome (CHS)

This is a condition that has recently been recognized as a syndrome that can be caused by a number of cannabinoids, when they are used regularly. Cannabinoid products are the street drugs most frequently used all over the world (Simonetto et al., 2012). It is estimated that almost 5% of the world population has used cannabinoid products (Sorensen et al., 2017). The three cannabinoids found in the actual cannabis plant are cannabidiol, tetrahydrocannabinol, and cannabigerol, which may all lead to the syndrome. Nowadays there are a variety of "synthetic cannabinoids" that could be similarly associated.

Cannabinoid hyperemesis syndrome is seen most often in young adults and adolescents who use cannabinoids regularly. The vomiting effect is paradoxical, as normally cannabinoids have an antiemetic effect. It is characterized by episodes

of intense vomiting which last two or three days and may improve spontaneously (Galli et al., 2011). It is thought that the affected youngster may learn through experience that taking repeated hot baths improves the feeling of nausea and vomiting (Allen et al., 2004). Clinical improvement after frequent hot baths or showers is so characteristic that this is considered a diagnostic indicator. The syndrome also includes abdominal pain. If the vomiting is severe, it may require hospitalization to correct the electrolyte balance. It can be misdiagnosed as cyclic vomiting. The repeated episodes of emesis can also lead to abdominal pain.

The syndrome often includes a prodromal phase, then the actual vomiting which may last 48 h, followed by a recovery phase. During the vomiting stage, the patient may require medication to diminish vomiting and intravenous liquids to compensate for the loss of fluid.

There is little information as to which adolescents or adults who chronically consume cannabinoid products will develop the syndrome. Generally, when the use of the cannabinoid ceases, the syndrome disappears. Otherwise, it has a cyclical pattern too, repeating its occurrence every few months. A case series of almost 100 patients with the syndrome found that most affected patients have used cannabis more than once per week for at least two years (Simonetto et al., 2012). A systematic review of cases found that around 70% of patients are male (Sorensen et al., 2017).

Psychological Manifestations and Treatment

Here, the central strategy for intervention is to reduce or cease the use of marijuana products. This may be a difficult endeavor for some adolescents and families. Clearly, there are multiple societal and cultural factors involved, which may include exposure to role models, peers who use cannabinoids, and the wish to belong to a peer group. At the individual level, there may be a need to alleviate tension, to "escape" difficult circumstances through the effects of the drug, as well as at times, dealing with intolerable mental states, such as dissociative experiences or post-traumatic symptoms. A combination of a program to reduce drug use (drug rehabilitation) with a psychotherapeutic approach directed to the child and/or family is desirable.

Aerophagia

Aerophagia is increasingly being recognized and diagnosed in children and adolescents (as well as adults). It consists of excessive air swallowing and its introduction in the gastrointestinal system. It leads to a feeling of being bloated and repeated belching (Chitkara et al., 2006). It is often associated also with abdominal distension and flatulence (Morabito et al., 2014). If it is intense, it can lead to abdominal cramps, diminished appetite, and frequent burping. The symptom of abdominal distention is important because it can lead to abdominal pain, discomfort, and it can be associated with constipation.

The Rome IV criteria for aerophagia are as follows: (1) excessive air swallowing, (2) abdominal distension due to intraluminal air which increases during the day, (3) repetitive belching and/or increased flatus, (4) symptoms cannot be fully explained by another medical condition, and (5) symptoms must be present at least two months before diagnosis.

Signs of functional aerophagia include a child who feels well in the morning, but as the day progresses, his abdominal distension increases. The child can be seen and heard swallowing or gulping air, which at times is done loudly. There is then excessive flatulence, particularly during the night (Hwang et al., 2005). Some authors call functional aerophagia "pathological" when it is associated with frequent burping, abdominal pain, and intense flatulence.

The condition is thought to be more frequent in children with intellectual handicap. It has been estimated to have a prevalence of more than 8% in the population with neurocognitive disabilities (Loeing-Baucke, 2000).

In terms of pathophysiology, aerophagia has been associated with an involuntary and paroxys-

mal opening of the cricopharyngeal sphincter; this opening is then followed by air swallowing but without cricopharyngeal swallowing movement sequences (Hwang et al., 2005).

Differential Diagnosis

A reason to recognize this condition is to avoid unnecessary and costly studies that could be performed to rule out more serious conditions. The studies themselves may lead to complications (Caplan et al., 2005; Drossman & Dumitrascu, 2005; Drossman & Hasler, 2016).

The clinical picture of aerophagia should be distinguished from "motility disorders" in the gastrointestinal tract, which are multiple: gastroparesis, megacolon, and intestinal pseudo-obstruction. For children who have obstructive sleep apnea and sleep with a CPAP (continuous positive air pressure) machine, significant aerophagia may occur due to the pressure of the machine during the night.

Psychological Manifestations

Anxiety can increase aerophagia. Self-stimulation may be involved, such as in cases of rumination, deliberate regurgitation of food, and other self-stimulating behaviors such as head-banging and hair-pulling. The child may learn that through performing certain behaviors, he has some agency, and he may enjoy the sensation of swallowing repeatedly. Also, it can be calming for the child to engage in what is repetitive and familiar; it may help him cope with distress, loneliness, or lack of attention from caregivers.

Treatment

Treatment can include behavioral therapy to teach the child a different way to express distress or anxiety, and if necessary, a psychotherapeutic intervention tailored to the issues faced by the child or family. The child may be taught to use other means to soothe himself, such as breathing, engaging the mind in some manual activity, changing the scenery, or engaging in interpersonal activities with a caregiver. The "learned behaviors" used for purposes of self-soothing are not easily abandoned if there is nothing else—more adaptive and pleasurable behaviors—with which to substitute them.

Reflux Hypersensitivity Syndrome

This condition is a new one in the Rome IV classification of brain–gut conditions. It was previously called "functional heartburn". Gastroesophageal reflux is a very common condition that is diagnosed from infancy through the oldest adult. It is a frequent reason for presentation to a physician. In the infant, reflux can lead to pain and excessive crying. In the older child or adolescent, it seems to lead to intense pain in the epigastric and retrosternal areas. Gastroesophageal reflux can be "erosive" due to the effect of gastric acid, or "non-erosive" if there is no damage to the esophageal mucosa. In fact, in the case of reflux hypersensitivity syndrome, there is no actual reflux and no dysfunction of the lower esophageal sphincter. So the problem here is the sensation of pain and discomfort without a physical cause for it. However, there is a heightened perception of pain in the esophagus which resembles that felt with gastroesophageal reflux.

Psychological Manifestations and Treatment

Several authors (Katzka et al., 2020) have emphasized the influence of anxiety, hypervigilance, and stress in reflux hypersensitivity. The central nervous system and visceral hypersensitivity are associated.

If the child or adolescent is overly focused on the functioning of the digestive system and is hyper-aware of these signals, so to speak, the question arises as to why. The child may experience an unstimulating environment, or not have much activity or engagement with others. Alternatively, her worry about her body may be a learned behavior from caregivers who have similar concerns. If her anxiety and concern are very

intense leading to a lot of discomfort, cognitive and behavioral strategies may be useful to deal with the persistent thoughts of illness or "being in danger of getting sick." Other interventions to focus her mind, find amusement, or to relax, such as meditation and yoga, may be helpful.

Functional Dyspepsia

Functional dyspepsia is a fairly frequent condition in children. The frequency has been estimated in a very high range—between 2% and 17% of children in different surveys (Ganesh & Nurko, 2014). Its main feature is abdominal pain or abdominal discomfort in the child or adolescent, particularly pain localized above the umbilical area. The associated decreased gastric motility can be felt as a sensation of fullness for a long time after eating. There can also be early satiation after barely having begun eating. The pain or discomfort is not alleviated by defecation. Also, there is no demonstrable organic pathology that can be identified as the cause of the pain. It has quite a negative impact on the quality of life of the child and family. It can account for a considerable difficulty in attending school or other social activities, depending on the frequency and severity of the discomfort or pain.

The Rome IV diagnostic criteria for functional dyspepsia are as follows: (1) postprandial fullness (an excessive feeling of fullness in the abdomen after eating), (2) early satiation, (3) epigastric pain or burning not associated with defecation, and (4) symptoms must be experienced for at least two months before diagnosis. Of note, the term "discomfort" is not included in the latest classification as it has different meanings in different cultural groups and it is difficult to characterize.

Differential Diagnosis

Contrary to public perception, *Helicobacter pylori* is not a frequent cause of functional dyspepsia. Common accompanying findings in the diagnosis of functional dyspepsia are delayed gastric emptying, a hypersensitivity to distension of the stomach, as well as antral hypomotility and gastric dysrhythmia (Ganesh & Nurko, 2014).

Psychological Manifestations

Depression and anxiety often correlate with functional dyspepsia, according to various studies. Features of perfectionism and alexithymia have also been associated (Shoji et al., 2018). In other words, the child—even a young child—may be excessively sensitive or a worrier. He may have separation anxiety, for instance, in the mornings before school or on Sundays before the school week starts. He may worry excessively, which manifests in uncomfortable sensations in the abdomen. Also, other children who do not experience their emotions may "bottle up" their feelings—fear, tension, and anger—which seemingly only manifest in the form of gastric symptoms.

Other possible contributors are anxiety and constant tension from family emotional or environment difficulties, school difficulties, or other interpersonal problems. Some children with academic difficulties may struggle to accept that they need additional help, and instead, prefer to avoid schoolwork, or may refuse to go to school altogether, or they may feel the pain when they are faced with difficult tasks.

Treatment

The treatment should be multimodal and multidisciplinary. Proton-pump inhibitor medications are recommended when there is a predominance of pain, and gastric motility accelerator medications are suggested for postprandial fullness or early satiety. Emotional factors such as tension, irritability, and anger may need to be taken into account depending on the child. On school days, there may be more reflux, pain, and avoidance behaviors. This should be addressed as a part of a comprehensive program of intervention.

Abdominal Migraine

The Rome criteria for abdominal migraine are as follows:

1. In the preceding 12 months, three or more paroxysmal episodes of intense, acute, midline abdominal pain lasting two hours to several days, with intervening symptom-free intervals lasting weeks to months. The pain is severe enough to interfere with normal activities.
2. Evidence of metabolic, gastrointestinal, or central nervous system structural or biochemical diseases is absent.
3. Two of the following features are present:

Headache, anorexia, nausea, vomiting, photophobia (sensitivity to light), or pallor.

There is often a family history of migraines. If headaches are present, they are confined to only one side of the head. There may be an aura (i.e., abnormal perceptions before the pain), or visual alterations such as blurred vision or a temporarily restricted visual field. There may also be motor abnormalities (inability to speak, slurred speech, or transient paralysis). There is also an association with limb pain.

Psychological Manifestations and Treatment

It is known that under conditions of more stress, migraines are more likely to occur.

The intervention for the actual pain is similar to the treatment of migraine headaches, for instance with the use of sumatriptan or another "triptan" medication, as well as propranolol, cyproheptadine, and pizotifen, which is an antagonist of 5-hydroxytryptamine. These medications sometimes abort the pain. The second phase of treatment is prophylactic or preventive. It may include the use of medications also used for the prevention of migraine headaches, such as propranolol, some anticonvulsants like topiramate, among others. Some physicians recommend lifestyle changes. A regular routine for sleep and wake may be useful. Some recommend dietary changes, like avoiding chocolate, cold-cured meats, and other foods which may provoke an episode.

This issue of sensitivity to stress may need to be emphasized. A very apprehensive child with catastrophical thoughts, who worries about many possible things that can go wrong, might benefit from a cognitive approach or an approach to diminish his or her exposure to family stressors and adverse circumstances, or if possible, the resolution of family conflicts and struggles.

Unexplained Abdominal Pain, Functional Abdominal Pain, or Centrally Mediated Abdominal Pain Syndrome

Abdominal pain is one of the most common complaints of children leading to consultations with the pediatrician (Korterink et al., 2015), and often eventually, with the pediatric gastroenterologist.

Among the diagnostic criteria of chronic abdominal pain is recurrent pain that lasts more than three months.

The Rome criteria for functional abdominal pain syndrome are:

At least twelve months of (1) continuous or nearly continuous abdominal pain in a school/age child or adolescent, (2) no or only occasional relation of pain with physiologic events (e.g., eating, menses, or defecation), (3) some loss of daily functioning, (4) the pain is not feigned (e.g., malingering), and (5)the child does not meet required criteria for other functional gastrointestinal disorders that would explain the abdominal pain.

The Rome consensus considers other diagnoses involving abdominal pain, such as functional dyspepsia. In functional dyspepsia, the pain can be persistent or recurrent, but it is centered in the upper abdomen (above the umbilicus). In both functional dyspepsia and functional abdominal pain, the pain is not relieved by defecation nor is it associated with changes in stool frequency or form, as opposed to irritable bowel syndrome, which will be discussed in the next section.

If other conditions are less likely, "*functional abdominal pain syndrome*" should be considered, which should include functional abdominal pain at least 25% of the time, as well as additional somatic complains such as limb pains, head-

aches, or difficulties with sleep, and loss of daily psychosocial functioning to some degree. The pain should occur at least once per week, lasting more than two months before the diagnosis can be made (Rasquin-Weber et al., 1999).

A 9-year-old girl, Celia, was referred to the psychiatric clinic due to unexplained abdominal pain. She had had extensive studies including imaging and endoscopies. She had abdominal pain almost every day or several times per week, and took analgesics regularly to relieve the pain. She also had difficulty eating because her stomach would "bloat" and then she would have more pain. She also had constipation, but that did not explain the abdominal pain. She denied wanting to be "thin" or other features of anorexia nervosa or bulimia.

During family therapy sessions it turned out she wanted to know about her father, who was in prison, but this was a taboo topic that could not be mentioned. The girl said she fantasized her father had robbed houses and said she would like to see him "to slap him thirty times" for not being a part of her life. Her mother was unable to go to work because she wanted to tend to her daughter. Her mother notably viewed Celia in an ambivalent light. The girl "controlled her family" with her symptoms. Celia was very strong-willed, and if she wanted to go somewhere and her mother said, "no," she would say, "I just lost my appetite," or, "I am not eating," or, "my stomach is hurting." She did not seem to be lying, but was very emotional and angry. Her mother was able to see, when the therapists pointed this out, that the child had "a lot of power "in the relationships at home and also would "use her pain as a weapon." Celia harbored much resentment toward her mother, who had several serial romantic partners who would then leave them. As the mutual anger between the patient and her mother was made more explicit, they could talk about it. Her abdominal pain began to decrease and the child started to eat more normally. Before treatment, she would "chug water" to become full and then "lose her appetite." Celia stopped all this when she discussed her resentment toward her mother, father, and siblings, and the interventions addressed her fear of going to school. Eventually, her pain disappeared completely and her nasogastric tube was removed since she had gained weight.

Differential Diagnosis

The differential diagnosis requires a number of investigations. The mind–body connection is important and there is clearly an intimate relationship between some mental states, such as anxiety and tension, and increased activity of the gastrointestinal tract.

In the current thinking about functional abdominal pain, multiple factors are thought to be involved, including stressful life circumstances which may be associated with visceral hypersensitivity and dysmotility.

One of the differential diagnoses that should be kept in mind is "abdominal epilepsy" which may manifest as episodes of pain and can be misdiagnosed as "psychogenic pain." Another one is brucellosis as well as chronic intermittent porphyria, which can easily go undiagnosed (Scheer, 2008). Other conditions that need to be diagnosed adequately are lactose and gluten intolerances.

Psychological Manifestations and Treatment:

Specific difficult life events or chronic psychosocial stressors may be important determinants (Miranda, 2008), for instance, previous surgery for pyloric stenosis (Saps & Bonilla, 2011). Many children experience discomfort in the abdomen when presented with the prospect of a scary situation, such as going to school, separating from parents, or facing a difficult examination or competition of some kind. In the normal child, this may feel like "butterflies in the stomach," but this sensation may go beyond that to actual pain, which may be quite intense. Treatment involves addressing the underlying precipitating factors, as demonstrated in Celia's case.

Irritable Bowel Syndrome

Irritable bowel syndrome (IBS) is a condition that tests the possibility of collaboration between the pediatrician or gastroenterologist and the mental health professional. A category called "interface disorders" (Heningsen & Herzog, 2008) has been suggested as a "common ground" in which there is less discussion or disagreement on whether the presentation is "purely organic"

or "purely psychogenic" in nature. In clinical practice, this may be difficult to delineate with such precision as many patients best fit into this "interface" state.

In the modern view, irritable bowel is a diagnosis that does not necessarily imply etiological assumptions as to psychological or organic factors, but it is seen as a phenomenon by itself. Physicians often recognize there are other "extra-gastrointestinal" factors in the affected patient (Heningsen & Herzog, 2008).

The Rome IV criteria for irritable bowel syndrome are applied for children old enough to provide an accurate pain history. At least 12 weeks of symptoms, which need not be consecutive, are required for diagnosis. In the preceding 12 months, the child meets these criteria:

1. Abdominal discomfort or pain with at least two of these three features: (a) relieved by defecation or associated with bowel movements, (b) onset is associated with a change in frequency of bowel movements, and (c) onset is associated with a change in form (appearance) of stool.
2. There are no structural or metabolic abnormalities to explain the symptoms.

Generally, there are episodes of abdominal pain or just a sensation of abdominal discomfort, which may or may not be associated with a sensation of bloating. There are changes in the nature of the stools, which are termed "irregularities" in the stool. It appears that the "irritable bowel" condition can have several subtypes, and different presentations may constitute groups with different etiologies and phenomenology. Subtypes include a predominance of abdominal pain/discomfort, constipation, diarrhea, mixed, and an "undifferentiated" type. The Rome IV criteria, however, consider that the previously differentiated "types" of irritable syndrome as predominantly with diarrhea, and predominantly with constipation, or a mixed pattern, exist in a continuum and are no longer considered as different entities. To support this, studies that find a certain vulnerability in a group of patients fail to show the same in a second similar group of patients, such as variation in the intestinal flora, history of the previous infection, or biometric markers.

The movement of the bowel is determined by multiple factors. For instance, the visceral sensations (which are affected by the mucosal barrier in the intestine), the quantity and quality of microbiota in the gut, antigens present in food and bile acids, and other factors can all contribute to the excessive irritability and altered motility in IBS. These factors lead to dysregulation in the sensorimotor function of the gut, as well as alterations in the hypothalamic-pituitary-adrenal axis, the immune system, brain–gut axis, and enteric nervous system. It is also clear that emotions influence the function of the gastrointestinal tract, particularly in this condition.

It is clear that in subgroups of patients, there is an altered immune response, greater permeability of the gut mucosa (leading to diarrhea), as well as abnormalities in the inflammatory response. What is not clear is whether or not, and to what degree, these are the underlying mechanisms producing the symptoms (pain, diarrhea, sensitivities), or rather, to what extent environmental and emotional factors are at play. There may be bidirectional effects. Many patients with irritable bowel syndrome have higher levels of 5-hydroxytryptamine in the gut where the majority of it is produced anyway (90% of 5-hydroxytryptamine in our body is produced in the endocrine cells in the bowels, which is necessary for the growth of certain bacteria).

The prevalence in the general population of adults has been estimated fairly high, around 11% of adults (Enck et al., 2015. Lovell & Ford, 2012), with a similar prevalence in children and adolescents (Dong et al., 2005). However, there was a much higher prevalence in Korean girls at 18% (Son et al., 2009). Having the syndrome in childhood does not necessarily mean persistence into adulthood (Goodwin et al., 2013).

Most experts currently recommend to base the diagnosis of irritable bowel syndrome on the symptoms described above, and not to engage in an endless process of imaging and other studies (Longstreth et al., 2006). There is no specific biomarker to confirm the diagnosis. The pattern of "irregularity" in the frequencies of defecations is an important criterion. This can be described as more than three stools per 24-h period for diarrhea and less than three stools per week for

constipation. In many patients, there is alternation between too loose and too hard stools. Also, the youngster may report urgency (needing to go to the toilet very soon) as well as a feeling of not having completed the evacuation (tenesmus), as well as the presence of mucus in the stools. None of these are pathognomonic symptoms, however. The patient may also report other gastrointestinal alterations that are comorbid. She or he may experience other somatic complaints, such as headaches, pain, fatigue, as well as depression and/or anxiety which all support the diagnosis. There are a number of "alarm symptoms," including very severe symptoms, and abnormal findings in laboratory tests or on physical examination that may necessitate further studies such as a colonoscopy and tests to rule out celiac disease and carbohydrate malabsorption. Other alarm signs are unintended weight loss, loss of more than 10% of body weight in a 3-month period, blood in stools (not from hemorrhoids or anal fissures), symptoms that awaken the patient at night, fever, and a family history of colorectal cancer, inflammatory bowel disease, or celiac disease.

Psychological Manifestations

There seems to be a strong association between emotional difficulties, such as anxiety, depression, a tendency to "somatization" in affected patients, as well as "neuroticism" in general. Also, there is a co-occurrence with other conditions such as gastroesophageal reflux, functional dyspepsia, nausea, and other gastrointestinal symptoms. Patients may not fit neatly in one "strict classification" but have a variety of complaints. As in all children and adolescents, we find interpersonal influences and stressors from school, family, and peer groups as important contributing factors.

Many young people who suffer from irritable bowel syndrome are quite anxious. There is a tendency to a "catastrophic thinking" pattern upon the perception of movement in the gut, or a "hypersensitivity" to the intestines, particularly toward the perception of pain and maximizing that perception (Lackner & Gurtman, 2004). It has also been shown that the brain, through the autonomous nervous system and the HPA axis, has an influence on gut motility, the quality of the microbial composition in it, as well as the permeability of the epithelial membrane.

Treatment

The clinician should consider "three arms" in the management of irritable bowel syndrome: nutritional, pharmacological, and complementary and alternative interventions (Chiou & Nurko, 2010. Bollom & Lembo, 2015). Serotonin reuptake inhibitor antidepressants (SRIs) and tricyclic antidepressants (TCAs) are used in other conditions at low doses to treat chronic pain. They are not approved officially for use in abdominal pain associated with irritable bowel syndrome, but physicians use them at times "off-label."

Regarding psychological management, the general principles of reducing stress, anxious cognitions, catastrophic thinking, learning to relax, and resolving interpersonal problems should be helpful. The treatment must be individualized, as there may be factors like bullying, academic problems, interpersonal difficulties, family tensions, and discord, among many other possibilities which may require a complex multimodal approach. The four most used therapeutic strategies are the following: cognitive-behavioral therapy, psychodynamic psychotherapy, gut-directed hypnosis, and mindfulness-based psychotherapy.

Regarding hypnosis, the therapist should prepare the patient as to what hypnosis is, and once accepted, provide metaphors during the trance in which the patient visualizes calm images and thus promotes normal movement of the intestines and a feeling of relaxation. Yoga has also been suggested as a useful intervention (Kuttner et al., 2006; Evans et al., 2014). Acupuncture also has been used as a complementary intervention. There are a number of alternative strategies including the use of some spices like turmeric extract, artichoke leaf extract, iberogast (which is a combination of several extracts), ginger root,

and an infusion of ginger, primrose oil, and peppermint oil, among many others. Probiotics and prebiotics also can be used in an attempt to stabilize the intestinal flora. For instance, *Bifidobacterium infantis* has been demonstrated to improve symptoms (Bollom & Lembo, 2015).

Functional Constipation

The Rome III criteria for functional constipation are as follows:

In infants and preschool children, at least two weeks of:

1. Scybalous, pebble-like hard stools for a majority of stools.
2. Firm stools two or three times per week.
3. There is no evidence of structural, endocrine, or metabolic disease.

Functional Fecal Retention

In the young child, functional fecal retention may be the result of painful evacuations, as a learned response to such pain. Therefore, the child fears defecating, which only perpetuates the problem (Hyman et al., 2006).

The Rome III criteria for functional fecal retention are as follows:

From infancy to 16 years old, a history of 12 or more weeks of:

1. Passage of large-diameter stools at intervals less than two times per week.
2. Retentive posturing, avoidance of defecation by purposeful contraction of the pelvic floor, and consequential pelvic floor muscle fatigue as the child uses the gluteal muscles to squeeze the buttocks together.

Functional Encopresis

The Rome III criteria for non-retentive fecal soiling are:

A history of the following symptoms in a child four years or older at least once per week:

1. Defecation in inappropriate places or social contexts.
2. There is an absence of structural or inflammatory disease.

The child with encopresis at times first tries to retain the feces or control the defecation for long periods of time. When he retains feces, the feces in the large bowel above the rectum can "leak" around the compact feces and produce leakage and soiling of the underwear.

Psychological Manifestations and Treatment

There are multiple reviews of the frequency and mechanisms leading to the encopretic phenomena, which can persist into adolescence. Here we mostly highlight the psychodynamic issues which we have frequently encountered when dealing with multiple children or teenagers who have encopresis.

One scenario is the desire to be a younger child. This can occur because the child is afraid of becoming older, after the birth of a sibling or after a major stressor. Not controlling the feces is a mechanism by which the child conveys the message of needing diapers and not being a "big boy" or a "big girl," or saying that he wants to grow, but the body functioning suggests the opposite as with the frequent fecal "accidents." Often a therapist is consulted by parents of a four or 5-year-old child who is perfectly capable of defecating in a toilet or potty chair, but prefers to do so in his diaper. The child may actually verbalize the wish to continue to do so because he does not want to give up his diaper and it is more comfortable this way. The therapist may then wish to work on persuading the child to want to act like a child of his age. Perhaps one can point to the advantages of being older and explore his fears of getting older in more detail.

Another mechanism in encopresis is traumatic experiences around toileting. This could include falling in the toilet, having had an "accident" in the toilet, being afraid that one might "fall inside" the toilet, or that an animal can come out of it to bite the child. These fears are common in pre-

school children and may persist for a long time, if unaddressed. Other children with sensory integration difficulties dislike the toilet seat because it is "too cold" or because of the scary noise that the water makes when the toilet is flushed. Here there may be alternatives such as warming the toilet seat first, using ear plugs to minimize the intensity of the noise, or waiting for the child to leave the toilet to flush it.

Another common scenario is the wish for the child to "feel special" in a group of many siblings or with parents who are very busy with their own affairs. The child becomes, so to speak, a "specialized person" in defecating in his or her pants. The child may sense that when the parents start to smell the feces, they notice her and start asking questions about what happened. Her parents may take their child to the doctor, worry about giving her a special diet, etc., and all of this can make the child feel important, particularly if there are few other reasons for the child to feel special or noticed. Of course, another scenario of encopresis involves the covert expression of resentment and passive aggression toward caregivers. A battle of wills, so to speak, may be present. The child may compete with siblings or show anger toward the parents through the inappropriate defecations. The child may feel that he does not have a voice in his family and may feel very angry at his parents, or one parent, but be unable to express this directly due to the parenting strategies of his caregivers, who may be very strict and punish the child often. One way to "counterattack," so to speak, is the fecal accidents that lead to intense reactions by the parents, for instance, having to clean the bathroom and dealing with feces in the underwear. Some children go to great lengths to attack their parents with feces, for instance, depositing or concealing the soiled underwear in the mother's purse, the father's clean clothes, or inside the ventilation system of the house (air conditioner ducts, etc.). This comes close to an "attack with feces," which of course many animals use as a defense against predators.

The intervention in these circumstances is to address the "central" problem or problems, for example, improve the parent–child relationship, diminish the fears of an accident in the toilet, or make the child feel special in other ways, so that she can give up the underlying reason for her behavior. A purely behavioral system with positive rewards or with "negative consequences" often fails if the child has a stronger motivation to maintain the undesired action.

Burning Mouth Syndrome

As the name implies, the affected person experiences a sensation of constant burning in the mucosa of the mouth and tongue (Mignogna et al., 2011). The sensation may also be one of "sand" texture of the mucosa and the feeling that there is a foreign body in the affected areas. The problem has no medical explanation and is often associated with problems like anxiety, depression, and other symptoms of somatization. It also has been associated with chronic fatigue syndrome and with irritable bowel syndrome.

References

Allen, J. H., De Moore, G. M., Heddle, R., & Twartz, J. (2004). Cannabinoid hyperemesis: Cyclical hyperemesis in association with chronic cannabis abuse. *Gut, 53*(11), 1566–1570.

Benninga, M. A., Nurko, S., Faure, C., Hyman, P. E., Roberts, I. S. J., & Schechter, N. L. (2016). Childhood functional gastrointestinal disorders: Neonate/toddler. *Gastroenterology, 150*(6), 1443–1455.

Bollom, A., & Lembo, A. (2015). Complementary and alternative management strategies in irritable bowel syndrome. In B. E. Lacy, D. M. Crowell, & J. K. DiBaise (Eds.), *Functional and motility disorders of the gastrointestinal tract* (pp. 253–259). Springer.

Caplan, A., Walker, L., & Rasquin, A. (2005). Validation of the pediatric Rome II criteria for functional gastrointestinal disorders using the questionnaire on pediatric gastrointestinal symptoms. *Journal of Pediatric Gastroenterology and Nutrition, 41*(3), 305–316.

Chiou, E., & Nurko, S. (2010). Management of functional abdominal pain and irritable bowel syndrome in children and adolescents. *Expert Review of Gastroenterology & Hepatology, 4*(3), 293–304.

Chitkara, D. K., Bredenoord, A. J., Talley, N. J., & Whitehead, W. E. (2006). Aerophagia and rumination: Recognition and therapy. *Current Treatment Options in Gastroenterology, 9*, 305–313.

Devanarayana, N. M., de Silva, D. G., & de Silva, H. J. (2008). Aetiology of recurrent abdominal pain in a cohort of Sri Lankan children. *Journal of Paediatrics and Child Health, 44*, 195–200.

Dong, L., Dingguo, L., Xiaoxing, X., & Hanming, L. (2005). An epidemiologic study of irritable bowel syndrome in adolescents and children in China: A school-based study. *Pediatrics, 116*(3), e393–e396.

Drossman, D. A., & Dumitrascu, D. L. (2005). Rome III: New standard fur functional gastrointestinal disorders. *Journal of Gastrointestinal and Liver Diseases, 15*(3), 237–241.

Drossman, D. A., & Hasler, W. L. (2016). Rome IV-functional GI disorders: Disorders of gut-brain interaction. *Gastroenterology, 150*, 1257–1261.

Drossman, D. A., Thompson, W. G., Talley, N. J., Funch-Jeasen, P., & Janssens, J. (1990). Identification of subgroups of functional bowel disorders. *Gastroenterology International, 3*, 159–172.

Elenkov, I. J., & Chrousos, G. P. (2006). Stress system—Organization, physiology and immunoregulation. *Neuroimmunomodulation, 13*, 257–267.

Enck, P., Aziz, Q., Barbara, G., Farmer, A. D., Fukuda, S., Mayer, E. A., Eamonn, M., Quigley, M., Rajilic-Stojanovic, M., Schemann, M., Schwille-Kiunthe, J., Simren, M., Zipfel, S., & Spiller. (2015). Irritable bowel syndrome. *Nature Reviews. Disease Primers, 2*, 1–24.

Evans, S., Lung, K. C., Seidman, L. C., Sternlieb, B., Zeltzer, L. K., & Tsao, J. C. (2014). Iyengar yoga for adolescents and young adults with irritable bowel syndrome. *Journal of Pediatric Gastroenterology and Nutrition, 59*(2), 244.

Faure, C., Thapar, N. & DiLorenzo, C. (eds.) (2017). Pediatric Neurogastroenterology. Gastrointestinal motility and functional disorders in children.

Galli, J. A., Andari Sawaya, R., & Friedenberg, F. K. (2011). Cannabinoid hyperemesis syndrome. *Current Drug Abuse Reviews, 4*(4), 241–249.

Ganesh, M., & Nurko, S. (2014). Functional dyspepsia in children. *Pediatric Annals, 43*(4), e101–e105.

Goodwin, L., White, P. D., Hotopf, M., Stansfeld, S. A., & Clark, C. (2013). Life course study of the etiology of self-reported irritable bowel syndrome in the 1958 British birth cohort. *Psychosomatic Medicine, 75*, 202–210.

Haan, J., Kors, E. E., & Ferrari, M. D. (2002). Familial cyclic vomiting syndrome. *Cephalalgia, 22*(7), 552–554.

Haghighat, M., Rafie, S., Dehghani, S. M., Fallahi, G. H., & Nejabat, M. (2007). Cyclic vomiting syndrome in children: Experience with 181 cases from southern Iran. *World Journal of Gastroenterology, 13*(12), 1833–1836.

Heningsen, P., & Herzog, W. (2008). Irritable bowel syndrome and somatoform disorders. *Journal of Psychosomatic Research, 64*, 625–629.

Hwang, J. B., Choi, W. J., Kim, J. S., Lee, S. Y., Jung, C. H., Lee, Y. H., & Kam, S. (2005). Clinical features of pathologic childhood aerophagia: Early recognition and essential diagnostic criteria. *Journal of Pediatric Gastroenterology and Nutrition, 41*, 612–616.

Hyams, J. S., Di Lorenzo, C., Saps, M., Shulman, A. S., & Van Tilburg, M. (2016). Childhood functional gastrointestinal disorders: Child/adolescent. *Gastroenterology, 150*, 1456–1468.

Hyman, P. E., Milla, P. J., Benninga, M. A., Davidson, G. P., Fleisher, D. F., & Taminiau, J. (2006). Childhood functional gastrointestinal disorders: Neonate/toddler. *Gastroenterology, 130*, 1519–1526.

Katzka, D. A., Pandolfino, J. E., & Kahrilas, P. J. (2020). Phenotypes of gastroesophageal reflux disease: Where Rome, Lyon, and Montreal meet. *Clinical Gastroenterology and Hepatology, 18*(4), 767–776.

Keller, K., Beule, J., & Dippold, W. (2013). Cyclic vomiting syndrome in adults. *Wiener Medizinische Wochenschrift, 163*, 514–516.

Kerr, C. A., Grice, D. M., Tran, C. D., Bauer, D. C., Li, D., Hendry, P., & Hannan, G. N. (2014). Early life events influence whole-of-life metabolic health via gut microflora and gut permeability. *Critical Reviews in Microbiology, 41*(3), 326–340.

Korterink, J., Devanarayana, N. M., Rajindrajith, S., Vlieger, A., & Benninga, M. A. (2015). Childhood functional abdominal pain: Mechanisms and management. *Nature Reviews Gastroenterology & Hepatology, 12*(3), 159–171.

Kuttner, L., Chambers, C. T., Hardial, J., Israel, D. M., Jacobson, K., & Evans, K. (2006). A randomized trial of yoga for adolescents with irritable bowel syndrome. *Pain Research & Management, 11*(4), 217–223.

Lackner, J. M., & Gurtman, M. B. (2004). Pain catastrophizing and interpersonal problems: A circumplex analysis of the communal coping model. *Pain, 110*, 597–604.

Lewis, M. L., Palsson, O. S., Whitehead, W. E., & van Tilburg, M. A. L. (2016). Prevalence of functional gastrointestinal disorders in children and adolescents. *The Journal of Pediatrics, 177*, 39–43.

Li, B. U. K. (2001). Cyclic vomiting. Age-old syndrome and new insights. *Seminars in Pediatric Neurology, 8*(1), 13–21.

Loeing-Baucke, V. (2000). Aerophagia as cause of gaseous abdominal distension in a toddler. *Gastroenterology and Nutrition, 31*, 204–207.

Longstreth, G. F., Thompson, W. G., Chey, W., Houghton, L. A., Mearin, F., & Spiller, R. C. (2006). Functional bowel disorders. *Gastroenterology, 130*, 1480–1491.

Lovell, R. M., & Ford, A. C. (2012). Global prevalence of and risk factors for irritable bowel syndrome: A meta-analysis. *Clinical Gastroenterology and Hepatology, 10*, 712–721.

Mayer, E. A., Bradesi, S., Chang, L., Spiegel, B. M., Bueller, J. A., & Naliboff, B. D. (2008). Functional GI

disorders: From animal models to drug development. *Gut, 57*, 384–404.

McOmber, M. A., & Shulman, R. J. (2008). Pediatric functional gastrointestinal disorders. *Nutrition in Clinical Practice, 23*(3), 268–274.

Mignogna, M. D., Pollio, A., Fortuna, G., Leuci, S., Ruoppo, E., Adamo, D., & Zarrelli, C. (2011). Unexplained somatic comorbidities in patients with burning mouth syndrome: A controlled clinical study. *Journal of Orofacial Pain, 25*(2), 131–140.

Miranda, A. (2008). Early life events and the development of visceral hyperalgesia. *Journal of Pediatric Gastroenterology and Nutrition, 47*, 682–684.

Morabito, G. L., Romeo, C., & Romano, C. (2014). Functional aerophagia in children: A frequent, atypical disorder. *Case Reports in Gastroenterology, 8*, 123–128.

Noejovich, C. V., Miranda, P. M., Collins, S. M., Verdu, E., Pinto-Sanchez, M. I., & Bercik, P. (2020). Adverse early life events are common in patients with functional and organic gastrointestinal disorders. *Journal of the Canadian Association of Gastroenterology, 3*(Supp.1), 26–27.

Park, R., Mikami, S., Leclair, J., Bollom, A., Lembo, C., Seth, S., Lembo, A., Jones, M., Cheng, V., Friedlander, E., & Nurko, S. (2015). Inpatient burden of childhood functional GI disorders in the USA: An analysis of national trends in the USA from 1997 to 2009. *Neurogastroenterology and Motility, 27*, 684–692.

Rasquin-Weber, A., Hyman, P. E., Cucchiara, S., Fleisher, D. R., Hyams, J. S., Milla, P. J., & Staiano, A. (1999). Childhood functional gastrointestinal disorders. *Gut, 45*(suppl 2), II60–II68.

Robin, S. G., Keller, C., Zwiener, R., Hyman, P. E., Nurko, S., Saps, M., Di Lorenzo, C., Shulman, R. J., Hyams, J. S., Patsson, O., & Van Tilburg, M. A. L. (2018). Pediatric functional gastrointestinal disroders utilizing the Rome IV criteria. *The Journal of Pediatrics, 195*, 134–139.

Saps, M., & Bonilla, S. (2011). Early life events: Infants with pyloric stenosis have a higher risk of developing chronic abdominal pain in childhood. *The Journal of Pediatrics, 159*(4), 551–554.

Saps, M., Nichols-Vinueza, D. X., Rosen, J. M., & Velasco-Benítez, C. A. (2014). Prevalence of functional gastrointestinal disorders in preschool children. *The Journal of Pediatrics, 130*(5), 1527–1537.

Scheer, P. (2008). Funktionelle Bauchschmerzen aus der Sicht der pëdiatrischen Psychosomatik. *Pädiatrie und Pädologie, 3*, 30–31.

Schmulson, M. J., & Drossman, D. A. (2017). What is new in Rome IV. *Journal of Neurogastroenterology and Motility, 23*(2), 151–163.

Shoji, T., Endo, Y., & Fukudo, S. (2018). Psychogastroenterology. In K. Tominaga & H. Kusunoki (Eds.), *Functional dyspepsia* (pp. 105–116). Singapore.

Simonetto, D. A., Oxentenko, A. S., Herman, M. L., & Szostek, J. H. (2012). Cannabinoid hyperemesis: A case series of 98 patients. *Mayo Clinic Proceedings, 87*(2), 114–119.

Slutsker, B., Konichezky, A., & Gothelf, D. (2010). Breaking the cycle: Cognitive behavioral therapy and biofeedback training in a case of cyclic vomiting syndrome. *Psychology, Health & Medicine, 15*, 625–631.

Son, Y. J., Jun, E. Y., & Park, J. H. (2009). Prevalence and risk factors of irritable bowel syndrome in Korean adolescent girls: A school-based study. *International Journal of Nursing Studies, 46*(1), 77–85.

Sood, R., & Ford, A. C. (2016). Rome IV criteria for FGIDs—An improvement or more of the same? *Nature Reviews Gastroenterology & Hepatology, 13*(9), 501–507.

Sorensen, C. J., DeSanto, K., Borgelt, L., Phillips, K. T., & Monte, A. A. (2017). Cannabinoid hyperemesis syndrome: Diagnosis, pathophysiology, and treatment—A systematic review. *Journal of Medical Toxicology, 13*(1), 71–87.

Zablah, R., Velasco-Benitez, C. A., Merlos, I., Bonilla, S., & Saps, M. (2015). Prevalencia de trastornos funcionales gastrointestinales en niños en edad escolar en El Salvador. *Revista de Gastroenterología de México, 80*(3), 186–191.

Kenia L. Gomez, PhD Clinical and developmental psychologist in the Department of Pediatric Newborn Medicine at Brigham and Women Hospital/Massachusetts General Brigham and an instructor of psychology at Harvard Medical School. She evaluates the developmental trajectory of babies who graduate from the NICU and is involved in the early detection of neurodevelopment disabilities, evaluation, care-coordination, and family support. She has extensive clinical experience in the area of perinatal mental health and infant parent attachment. PhD in counseling psychology at Loyola University Chicago, where she studied the relationship between subjective well-being, ethnic identify, and family satisfaction among Latin children.

Jessica DiCarlo, MD Assistant Professor of Psychiatry and Behavioral Sciences at the University of Texas Health Science Center at Houston (UTHealth). She works with children and adolescents who have complex medical problems and co-occurring emotional issues. She completed a pediatrics internship and psychiatry residency at Tufts Medical Center followed by a child and adolescent psychiatry fellowship at Baylor College of Medicine. Dr. DiCarlo is interested in medical humanities. She is board-certified in general and child/adolescent psychiatry.