# A Million-dollar Work-up for Abdominal Pain: Is It Worth It?

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**ABSTRACT**

**Background and Aim:** Pain-predominant-functional gastrointestinal disorders (PP-FGIDs) are common. The diagnosis is clinical and there are no biological markers to characterize these conditions. Despite limited evidence, investigations are commonly performed. The aim of the study was to investigate diagnostic practices, yield, and costs in children with PP-FGIDs.
**Patients and Methods:** Charts of all of the children older than 4 years diagnosed as having abdominal pain were reviewed. Results and costs of diagnostic investigations were analyzed.
**Results:** Of 243 children with abdominal pain, 122 (50.2%) had PP-FGIDs (79 girls, mean age 12.7 years). All of the children underwent diagnostic work-up. Complete blood cell count was done in 91.8% of patients. None had elevated white blood cells, platelets, and low albumin. Six had either elevated erythrocyte sedimentation rate or C-reactive protein, but none had elevation of both; 4 of these 6 cases underwent endoscopies with normal results in 3 cases; *Helicobacter pylori* was found in 1 case. One child had elevated tissue transglutaminase 1 only antibodies with normal endoscopy. Amylase, lipase, direct bilirubin, stool cultures, and ova or parasites were always normal. One child had intermittent elevation of aspartate aminotransferase and alanine transaminase. There were no significant abnormalities in urinalysis or electrolytes. Abdominal x-rays were done in 38.5%, showing only retained stools in 13% of these patients. Abdominal ultrasound and computed tomography scan were done in 23.7% and 9% of cases, respectively, but were of no clinical value; 33.6% patients had esophagogastroduodenoscopy (9.7% abnormal: *Helicobacter pylori*, chemical gastritis, esophagitis) and 17.2% had colonoscopy (9.5% abnormal: rare fork crypts, lymphoid hyperplasia). Total costs: $744,726. Average cost per patient: $6104.30.
**Conclusions:** In children with PP-FGIDs, investigations are common, costs are substantial, and yield is minimal.

**Key Words:** abdominal pain, children, cost, functional gastrointestinal disorders

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Pain-predominant-functional gastrointestinal disorders (PP-FGIDs) are common in children. Adult patients with irritable bowel syndrome use 50% more health care resources than those without irritable bowel syndrome (1). Care of adult patients with irritable bowel syndrome involves more than $20 billion/year in both direct and indirect expenditures (1). Although no pediatric data are available on the economic costs related to PP-FGIDs, it is likely to be significant. The diagnosis of PP-FGIDs is based on clinical symptoms. There are no structural abnormalities or biochemical markers that could lead to their diagnosis. A technical report by the American Academy of Pediatrics (AAP) and the North American Society for Gastroenterology, Hepatology, and Nutrition (NASPGHAN) on chronic abdominal pain (AP) stated that most children are unlikely to require diagnostic testing and found limited evidence for the indication of these investigations (2). Despite the limited data to support their use, diagnostic tests are commonly performed. A better understanding of the common practices and the yield of diagnostic testing could result in more efficient use of medical resources. We have conducted a study to investigate the costs of usage and the yield of diagnostic work-up in patients who were clinically diagnosed as having PP-FGIDs in a tertiary care center.

## PATIENTS AND METHODS

In this descriptive study, all of the charts of patients between 4 and 21 years of age, consulting for AP (*ICD-9* code 789.0) at Children's Memorial Hospital pediatric gastroenterology clinics from January 2005 to December 2008, were reviewed by a single pediatric gastroenterologist blinded to the laboratory results. This blinded chart reviewer performed the task of classifying the patients into those having functional or organic AP. Presence and intensity of AP, bowel habits, other gastrointestinal (GI) symptoms, and limitations in activities in the last 6 months were documented. Alarm symptoms or physical findings suggestive of an organic GI disorder were also noted. A validated questionnaire designed to diagnose FGIDs (QPGS-RIII) was used to classify each of these cases according to the Rome criteria (3–5).

### Inclusion Criteria

Patients who met criteria for PP-FGIDs according to the Rome III criteria and those who had more than 1 month of AP and met the rest of the criteria for PP-FGIDs.

### Exclusion Criteria

The exclusion criteria were the presence of any alarm symptoms or physical findings suggestive of an organic condition. These included unexplained fever, weight loss, hematemesis, hematochezia, protracted vomiting, chronic diarrhea, persistent right upper or right lower quadrant pain, family history of inflammatory bowel disease, and abnormal physical findings, such as localized fullness, hepatomegaly, splenomegaly, costovertebral angle tenderness or spine tenderness, and perianal abnormalities.

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## Methods

Laboratory, radiological, and endoscopic work-up for each patient was documented. Each case was reviewed to determine whether the work-up resulted in change of diagnosis and management. Costs for each diagnostic test and consultation were estimated using the amounts charged by the hospital to the payer in 2008. Costs of endoscopies included operating and recovery room charges, medications and supplies, anesthesia, and physician procedure fees. Per-patient costs estimates included charges for the initial pediatric GI consultation visit only. The study was approved by the institutional review board of Children's Memorial Hospital in Chicago, IL.

# RESULTS

Two hundred forty-three children with a primary diagnosis of AP were seen by 13 pediatric gastroenterology doctors and 2 nurse practitioners between January 2005 and December 2008. Of these, 121 children (49.8%) were diagnosed as having various organic conditions (eg, inflammatory bowel disease, diabetes, congenital anomalies, immune disorders, acute appendicitis) and were therefore excluded from the study. One hundred twenty-two children (50.2%), 79 girls (64.8%), mean age 12.7 years (range 4–20 years), were diagnosed as having a PP-FGID. All of the children included in the study had undergone at least 1 diagnostic investigation (Table 1) to rule out inflammatory bowel disease, celiac disease, and other inflammatory or infectious conditions.

## Laboratory Testing

Complete blood cell count was the most common investigation (91.8%), followed by a comprehensive metabolic panel that included electrolytes and liver function tests in 82.7% of the patients. Electrolytes were normal in all of the cases with the exception of 1 in which sodium was found to be mildly low (132 mEq/L). Glucose level was found to be mildly elevated (121–132 mg/dL) in 3.9% of these cases. Total bilirubin was abnormal in 5.9% of cases; none of these had elevation of direct bilirubin. Abnormal values in these tests did not result in changes in management of any patient. Elevated inflammatory markers and celiac antibodies led to changes in management in 5 cases. Elevated erythrocyte sedimentation rate (range 23–58 mm/h) or C-reactive protein (maximum value 1.1) was found in 6 cases (5.4%). No patient had elevation of both erythrocyte sedimentation rate and C-reactive protein. Four of these 6 patients with elevated inflammatory markers underwent endoscopy (3 normal, 1 *Helicobacter pylori* infection). Celiac panel was done in 52% of patients. Tissue transglutaminase antibodies were positive in 1 case (1.5%). This patient underwent endoscopy, which was normal. Pancreatic enzymes, stool studies, and urinalysis were normal or not clinically significant in all of the patients.

## Imaging Studies

Abdominal x-rays were done in 38.5% of patients. Retained stools was the only finding in 13% of these patients, and the rest were normal. Abdominal ultrasound and computed tomography scan results were normal in all of the cases.

## Endoscopic Studies

Esophagogastroduodenoscopy was performed in 33.6% of cases and colonoscopies in 17.2% of cases. Abnormalities were found in 4 esophagogastroduodenoscopies (9.7%) with evidence of *H pylori*, gastritis and esophagitis, and 2 colonoscopies (9.5%) that showed rare fork crypts and lymphoid hyperplasia.

## Costs Analysis

Total costs incurred by the patients in the study were $744,726. Average cost per patient with PP-FGID was $6104.30 (range $1052–$20,994) (Table 2).

# DISCUSSION

Adult studies have shown that FGIDs impose a substantial socioeconomic burden on families and society (1). Despite the high prevalence of PP-FGIDs in children, no studies have estimated the costs involved in management of these conditions. Our study seems to indicate that the costs related to PP-FGIDs in children in the United States are substantial. The average cost of evaluating each child in our study was $6104.30. This represents 77% of the annual per capita health care expenditure in the United States for 2007 ($7900 per capita) (6). The results of our study most likely underestimate the actual costs of evaluating a child with AP. The study only included the expenditure incurred by a single tertiary-level consultation and the associated investigation costs. Patients were referred to our institution by general pediatricians for an initial GI consultation or for a second or third opinion. Each of these physicians may have conducted additional investigations and management that resulted in costs not considered in our estimations.

The AAP Subcommittee on Chronic AP recommends that children with functional AP, who lack alarm signs or symptoms to suggest an organic disorder, be evaluated within primary care settings (7). The results of our study have important implications. The study shows that despite the AAP and NASPGHAN recommendations, patients are frequently referred to tertiary care centers and a large proportion of such patients eventually undergo extensive investigations. A study comparing diagnostic costs for FGIDs in children at primary and tertiary care centers showed that even with the same symptoms, children seen at the tertiary care center undergo more testing, which results in a 9-fold increase in costs (8).

In times of limited resources and a strained economy, the utility of laboratory investigations needs to be considered. Physicians should be aware of the costs and yield of testing. The AAP Subcommittee and NASPGHAN Committee on Chronic AP found no evidence to recommend common laboratory tests, such as complete blood cell count, erythrocyte sedimentation rate, comprehensive metabolic panel, urinalysis, and stool parasite analysis, in the evaluation of children with functional AP (2). Our study showed that despite these recommendations, it is common practice to order investigations in patients who meet criteria for FGIDs. Our study substantiates the recommendations of AAP and NASPGHAN because almost none of the laboratory investigations conducted changed the primary diagnosis or management.

The AAP and NASPGHAN Committee also found no evidence to substantiate the use of ultrasonographic examination of the abdomen or pelvis in the absence of alarm symptoms (2). Twenty-nine of our patients underwent ultrasound without benefit. A combination of elevated white blood cell counts, platelets, and low albumin commonly sought to rule out that inflammatory bowel disease was not found in any of the study patients. One out of the 64 patients who were screened for celiac disease had positive celiac markers. The patient had HLA DQ8 allelic variant and no evidence of celiac disease on endoscopy. This may indicate a false-positive result or most likely a case of latent celiac disease. The finding of a

TABLE 1. Abnormal results of investigations in patients with PP-FGIDs

| Tests | No. patients evaluated | Percentage of patients evaluated | No. patients with abnormal results | Percentage of patients with abnormal results |
|---|---|---|---|---|
| WBC | 112 | 91.8 | 6 | 5.3 |
| RBC | 112 | 91.8 | 13 | 11.6 |
| Hb | 112 | 91.8 | 6 | 5.3 |
| Hct | 112 | 91.8 | 7 | 6.2 |
| MCV | 112 | 91.8 | 3 | 2.6 |
| Platelets | 112 | 91.8 | 3 | 2.6 |
| Lymphocytes | 112 | 91.8 | 22 | 19.6 |
| Neutrophils | 112 | 91.8 | 18 | 16 |
| Eosinophils | 112 | 91.8 | 6 | 5.3 |
| ESR | 79 | 64.7 | 3 | 3.7 |
| CRP | 28 | 22.9 | 3 | 10.7 |
| Urinalysis | 68 | 55.7 | 24 | 35.2 |
| Celiac antibodies | 64 | 52.4 | 1 | 1.5 |
| IgA | 64 | 52.4 | 9 | 14 |
| Amylase | 78 | 63.9 | 0 | 0 |
| Lipase | 78 | 63.9 | 0 | 0 |
| Albumin | 101 | 82.7 | 6 | 5.9 |
| Bilirubin | 101 | 82.7 | 6 | 5.9 |
| Protein | 101 | 82.7 | 1 | 0.9 |
| ALP | 101 | 82.7 | 8 | 7.9 |
| ALT | 101 | 82.7 | 9 | 8.9 |
| AST | 101 | 82.7 | 3 | 2.9 |
| Sodium | 101 | 82.7 | 1 | 0.9 |
| Potassium | 101 | 82.7 | 3 | 2.9 |
| Chloride | 101 | 82.7 | 2 | 1.9 |
| $CO_2$ | 101 | 82.7 | 10 | 9.9 |
| Glucose | 101 | 82.7 | 4 | 3.9 |
| BUN | 101 | 82.7 | 13 | 12.8 |
| Creatinine | 101 | 82.7 | 1 | 0.9 |
| Calcium | 101 | 82.7 | 1 | 0.9 |
| Stool ova and parasite | 16 | 13.1 | 0 | 0 |
| Stool culture | 20 | 16.3 | 0 | 0 |
| EGD | 41 | 33.6 | 4 | 9.7 |
| Colonoscopy | 21 | 17.2 | 2 | 9.5 |
| Abdominal x-ray | 47 | 38.5 | 6 | 13 |
| Abdominal ultrasound | 29 | 23.7 | 0 | 0 |
| Abdominal CT scan | 11 | 9 | 0 | 0 |
| Upper GI–small bowel follow-through | 12 | 9.8 | 0 | 0 |

ALP = alkaline phosphatase; ALT = alanine transaminase; AST = aspartate aminotransferase; BUN = blood urea nitrogen; CRP = C-reactive protein; CT = computed tomography; EGD = esophagogastroduodenoscopy; ESR = erythrocyte sedimentation rate; GI = gastrointestinal; Hb = hemoglobin; Hct = hematocrit; IgA = immunoglobulin A; MCV = mean corpuscular volume; PP-FGIDs = pain-predominant functional gastrointestinal disorders; RBC = red blood cell; WBC = white blood cell.

single case of latent celiac disease in this sample size probably reflects the prevalence of this condition in the general population (9). *H pylori* was detected in 1 patient and was subsequently treated. Pediatric and adult studies have shown that the eradication of *H pylori* does not lead to the resolution of PP-FGIDs (10–12).

The study was conducted in a tertiary care center where physicians are probably aware of the task force recommendations but have not adopted them for their daily practice. Pediatric gastroenterologists are frequently referred patients with the expectation of conducting additional investigations by practitioners who may not be aware that the diagnosis of FGIDs is based on clinical symptoms. Physicians are many times uncomfortable with the diagnosis and management of FGIDs, and pursue testing in search of an answer to the diagnostic dilemma. Laboratory testing is frequently indicated to reassure physicians and parents of the nature of the condition. Conducting extensive work-up does not reassure the parents but in fact may lead them to believe that their child may have an occult life-threatening condition.

The limitations of our study include its retrospective nature, being conducted in a single tertiary care center, and the lack of study

TABLE 2. Cost of investigations and consultations in patients with PP-FGIDs (based on amount charged by the hospital to the payer in 2008)

| Tests | Subjects, n | Cost per unit, $ | Total costs, $ |
|---|---|---|---|
| CBC | 112 | 134 | 15,008 |
| ESR | 79 | 75 | 5925 |
| CRP | 28 | 31 | 868 |
| Amylase | 78 | 123 | 9594 |
| Lipase | 78 | 128 | 9984 |
| IgA | 64 | 132 | 8448 |
| Celiac antibodies | 64 | 492 | 31,488 |
| Complete metabolic profile | 101 | 284 | 28,684 |
| Urinalysis | 68 | 89 | 6052 |
| Stool culture | 20 | 269 | 5380 |
| Stool ova and parasite | 16 | 330 | 5280 |
| EGD | 41 | 5982 | 245,262 |
| Colonoscopy | 21 | 9222 | 193,662 |
| Abdominal x-ray | 47 | 314 | 14,758 |
| Abdominal ultrasound | 29 | 822 | 23,838 |
| Abdominal CT scan | 11 | 2631 | 28,941 |
| Upper GI–small bowel follow-through | 12 | 868 | 10,416 |
| Consultations | 122 | 829 | 101,138 |

CBC = complete blood cell count; CRP = C-reactive protein; CT = computed tomography; EGD = esophagogastroduodenoscopy; ESR = erythrocyte sedimentation rate; GI = gastrointestinal; IgA = immunoglobulin A; PP-FGIDs = pain-predominant functional gastrointestinal disorders.

data from referral doctors. We cannot affirm that the results of our study represent the practice variations of the whole pediatric GI community across the United States; however, it probably reflects the common practice of care. The study includes physicians and nurse practitioners with different levels of training and expertise. Our study only assessed the costs related to the evaluation of PP-FGIDs. The cost of the prescribed medications was not calculated. The care of children with PP-FGIDs results in additional indirect costs that have not been considered in our study. A study has shown that families frequently hire a babysitter to care for a child with AP, which adds $252 to the health care cost of a child with AP (13). Parents frequently missed work to care for a child with PP-FGIDs, resulting in an average loss of $313 in income (13). Presenteeism, characterized by the presence of a worker on the job without functioning optimally, is an additional component contributing to the health care costs (14). Parents of patients with PP-FGIDs may be afflicted by presenteeism because they worry about their sick child at home.

In view of the additional costs and low added value of conducting an extensive work-up in children with benign and transient conditions, our study underscores the need to educate primary care physicians on the management of FGIDs. Educating the families and children may avoid unnecessary referrals and costly testing. Disseminating effective approaches toward diagnosis and management of these disorders at the primary care level may help to improve patient satisfaction with care and decrease health care usage.

## CONCLUSIONS

We conclude that in children with PP-FGIDs, investigations are commonly sought. Diagnostic costs of PP-FGIDs are substantial, whereas their yield is minimal. Estimation of health care expenses is essential in the planning of public policies. The importance of conducting an accurate evaluation of the total expenditure involved in the care of a highly prevalent condition such as PP-FGID mandates a prospective study in a multicenter setting.

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