Functional Abdominal Pain in Childhood and Long-term Vulnerability to Anxiety Disorders

AUTHORS: Grace D. Shelby, PhD,a Kezia C. Shirkey, PhD,a Amanda L. Sherman, MS,b Joy E. Beck, PhD,b Kirsten Haman, PhD,a Angela R. Shears, BS,b Sara N. Horst, MD, MPH,b Craig A. Smith, PhD,a Judy Garber, PhD,a and Lynn S. Walker, PhDb

aDepartment of Psychology and Human Development, Vanderbilt University, Nashville, Tennessee; and Departments of bPediatrics, Medicine, and cPsychiatry, Vanderbilt University School of Medicine, Nashville, Tennessee

KEY WORDS functional gastrointestinal disorder, psychiatric disorders, anxiety, depression, pediatric, prospective

ABBREVIATIONS CI—confidence interval
DSM-IV—Diagnostic and Statistical Manual of Mental Disorders, 4th edition
FAP—functional abdominal pain
FGID—functional gastrointestinal disorder
FGID-POS—positive for FGID
FGID-NEG—negative for FGID
OR—odds ratio

Dr Shelby conducted psychiatric diagnostic interviews, drafted the initial manuscript, conducted data analyses, and reviewed and revised the manuscript; Dr Shirkey and Ms Sherman conducted psychiatric diagnostic interviews and critically reviewed the manuscript; Dr Beck supervised and conducted psychiatric diagnostic interviews, conducted data analysis, and critically reviewed the manuscript; Dr Haman supervised psychiatric diagnostic interviews, conducted data analysis, and critically reviewed the manuscript; Ms Shears coordinated data collection and critically reviewed the manuscript; Dr Horst reviewed medical records, conducted data analysis, and critically reviewed the manuscript; Dr Smith contributed to conceptualizing and design, supervised data analysis and critically reviewed the manuscript; Dr Garber contributed to conceptualizing and design, provided oversight of psychiatric diagnostic interviewing, and critically reviewed the manuscript; Dr Walker contributed to conceptualizing and design, supervised research activities, oversaw writing of the manuscript, and critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-2191
doi:10.1542/peds.2012-2191

Accepted for publication Jun 21, 2013

Address correspondence to Lynn S. Walker, PhD, Division of Adolescent and Young Adult Health, Monroe Carell Jr Children’s Hospital at Vanderbilt University, 2148 Belcourt Ave, Nashville, TN 37212. E-mail: lynn.walker@vanderbilt.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2013 by the American Academy of Pediatrics

(Continued on last page)
Chronic or recurrent abdominal pain affects 8% to 25% of school-age youth,1–3 is associated with frequent school absences,4–6 and accounts for 2% to 4% of pediatric clinic visits.7 Many patients, however, have no evidence of structural or biochemical abnormalities underlying their pain, and hence are considered to have medically unexplained or “functional” abdominal pain (FAP).8 The majority meet Rome III criteria for a functional gastrointestinal disorder (FGID) such as irritable bowel syndrome or functional dyspepsia.9 In addition, pediatric patients with FAP have high rates of anxiety and depression.10,11 Although several studies have evaluated the persistence of abdominal pain in patients with FAP,12 only 1 study evaluated diagnostic criteria for psychiatric disorders in these patients when they reached adulthood. In their seminal study, Campo et al13 identified 28 pediatric patients with medically unexplained recurrent abdominal pain by retrospective chart review and conducted telephone interviews with these patients when they were young adults. They found that, compared with a control group of patients without such history, those with recurrent abdominal pain in childhood were significantly more likely to meet diagnostic criteria for both lifetime and current anxiety disorders in adulthood. A decade later, this study remains the primary source of data on psychiatric outcomes into adulthood for pediatric patients with FAP. The small sample size, however, prohibited reliable evaluation of specific psychiatric diagnoses. Moreover, the study did not evaluate whether risk of psychiatric disorders in adulthood differed as a function of the persistence of abdominal pain. Thus, it is not known whether individuals with pediatric-onset FAP that resolves have rates of psychiatric disorders in adulthood comparable to those of individuals with no history of FAP; increased risk for psychiatric disorders might only characterize pediatric patients with FAP whose abdominal pain continues into adulthood.

This study prospectively followed pediatric patients with FAP and a control group of youth without FAP into adolescence and young adulthood. We hypothesized that individuals with a history of pediatric FAP would have significantly higher risk of anxiety and depressive disorders at follow-up compared with those without such history. We also evaluated rates of other psychiatric disorders, such as somatoform disorders, that have been linked to FGIDs.13,14 In addition, we evaluated whether risk of psychiatric disorders at follow-up in individuals with a history of FAP differed as a function of the persistence versus resolution of their abdominal pain, as defined by the Rome III criteria for FGIDs associated with abdominal pain.15 Finally, for those who met criteria for anxiety or depressive disorder, we evaluated the age of initial onset to determine whether the disorder preceded or followed the pediatric FAP evaluation.

METHODS

Participants

Participants were drawn from databases of (1) FAP: consecutive new patients, aged 8 to 17 years, evaluated by the Vanderbilt Pediatric Gastroenterology Service for abdominal pain of ≥3 month’s duration and (2) control subjects: children recruited from area schools in the same age range but without abdominal pain who participated in a health survey at school during the same time period (1993–2007).16–18 Participants were eligible for the follow-up study if they had reached ≥12 years of age and at least 4 years had elapsed since the baseline evaluation. Participants in the FAP database were excluded if their baseline medical evaluation had yielded evidence of significant organic disease (eg, inflammatory bowel disease). In addition, participants in either database who reported onset of chronic disease (eg, inflammatory bowel disease, celiac disease, multiple sclerosis) during the follow-up interval were excluded.

The follow-up entailed a comprehensive evaluation of health outcomes, some of which have been presented elsewhere.19–21 The current study focused on mental health outcomes. Of the 577 individuals (391 with FAP; 186 controls) who were eligible for this study, 491 participated (332 with FAP; 159 controls). Within the FAP and control groups, participants did not differ significantly from nonparticipants regarding age, gender, or baseline levels of abdominal pain. For participants under age 18 years, a parent also participated.

Measures Administered at Follow-up

The Anxiety Disorders Interview Schedule—IV: Adult Lifetime and Child and Parent Versions (ADIS)22–24 is a psychiatric diagnostic interview designed to assess current and lifetime Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) anxiety, mood, and other psychiatric disorders. A Clinical Severity Rating (range 0–8) of ≥4 (indicating at least moderate severity/impairment) is required for assigning a diagnosis. The Anxiety Disorders Interview Schedule has excellent interrater reliability, test-retest reliability, and concurrent validity.25,26 The adult version was used for participants aged ≥18. The child version incorporates both parent and child report into a combined score. To evaluate reliability, 2 diagnosticians (J.E.B. and K.H.) independently rated randomly selected audiotapes of 20% of the interviews.25 Diagnostic disagreements were resolved by consensus or in consultation with the senior diagnostician (J.G.). The κ coefficient regarding presence/absence of disorder ranged from good to excellent (κ = 0.76 for the presence of any anxiety disorder; κ = 1.0 for other disorders).
The Rome III Diagnostic Questionnaire for Functional Gastrointestinal Disorders\textsuperscript{15} assesses symptoms associated with the diagnostic criteria for abdominal pain–related FGIDs (irritable bowel syndrome, functional dyspepsia, abdominal migraine, functional abdominal pain). Participants’ responses were scored according to the pediatric Rome III criteria (for participants aged <18 years) or the adult Rome III criteria (for participants aged ≥18 years).

Hollingshead Index of Socioeconomic Status\textsuperscript{27} was based on the occupation and educational level of the participant or, for those aged <18 years, their parents. Scores can range from 8 (unskilled laborer) to 69 (professional). Scores of both spouses were averaged for married adults and for parents of adolescents.

**Procedure**

The protocol was administered in a face-to-face interview at Vanderbilt University Medical Center or, for those who could not travel to the medical center, by telephone. Interviewers were unaware of participants’ group status. Procedures were approved by the institutional review board.

**Data Analysis**

Analyses used Statistics 18 statistical package (SPSS, Inc, Chicago, IL). All variables met assumptions of normality. Analyses of variance and $\chi^2$ tests were used to evaluate group differences by age and gender. Probability values were 2-tailed, $P < .05$. Logistic regression analyses compared categorical dependent variables by group, controlling for age and gender.

**RESULTS**

**Sample Characteristics**

Of 332 previously identified patients with FAP who participated in the current study, 133 (40.1%) met criteria for an FGID associated with abdominal pain at follow-up (Table 1). Of the control group, 12 (7.5%) met criteria for a FGID at follow-up; they were excluded from further analysis because there were not enough of these cases to create a distinct comparison group on its own. Thus, the control sample comprised 147 individuals who did not report abdominal pain at baseline or at follow-up. The follow-up interval ranged from 4 to 16 years ($M = 8.49; SD = 3.25$) and age at follow-up ranged from 12 to 32 years ($M = 20.01; SD = 3.79$).

**Lifetime and Current Risk of Psychiatric Disorders**

Table 2 presents the lifetime and current risk of all major DSM-IV diagnoses for FAP and control groups. Table 3 presents odds ratios (ORs) and 95% confidence intervals (CIs) comparing the groups on the lifetime and current risk of any anxiety disorder and any depressive disorder, controlling for age and gender.

**Anxiety Disorders**

A significantly higher proportion of the FAP group met criteria for ≥1 lifetime anxiety disorders compared with the control group (51.2% vs 20.4%). The OR for any lifetime anxiety disorder was 4.59 times greater for the FAP group compared with controls (CI: 2.81–12.15; $P < .001$). The OR for current social anxiety disorder at follow-up was 8.14 times greater for the FAP group compared with controls (CI: 2.44–27.12; $P < .01$).

**Depressive Disorders**

A significantly higher proportion of the FAP group met criteria for a depressive disorder during their lifetime compared with the control group (40.1% vs 18.3%). The OR for any lifetime depressive disorder was 2.62 times greater for FAP compared with controls (CI: 1.56–4.40; $P < .001$). Risk for current depressive disorder at follow-up was low and did not differ significantly between groups.

**Other Psychiatric Disorders**

A higher proportion of the FAP group met criteria for lifetime and current somatoform disorders compared with control subjects (OR: 2.83–7.43; $P < .001$), with the highest risk of any anxiety disorder and any depressive disorder, controlling for age and gender.

**TABLE 1** Sample Characteristics

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Participant Group</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FAP ($n = 332$)</td>
<td>Controls ($n = 159$)</td>
</tr>
<tr>
<td>Sex (% Female)</td>
<td>63.8</td>
<td>54.4</td>
</tr>
<tr>
<td>Race/ethnicity (% white)</td>
<td>89.7</td>
<td>94.5</td>
</tr>
<tr>
<td>Age at initial evaluation (y)</td>
<td>11.77 (2.59)</td>
<td>10.82 (2.08)</td>
</tr>
<tr>
<td>Follow-up interval (y)</td>
<td>8.96 (3.49)</td>
<td>7.45 (3.21)</td>
</tr>
<tr>
<td>Age at follow-up (y)</td>
<td>20.68 (3.94)</td>
<td>18.46 (2.91)</td>
</tr>
<tr>
<td>Socioeconomic status at follow-up</td>
<td>39.60 (11.73)</td>
<td>37.46</td>
</tr>
<tr>
<td>FGIDs at follow-up</td>
<td>40.1%</td>
<td>7.5%*</td>
</tr>
<tr>
<td>IBS only</td>
<td>27.4</td>
<td>6.3%</td>
</tr>
<tr>
<td>FD only</td>
<td>17.8%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Other FGID (abdominal migraine, FAP)</td>
<td>5.4%</td>
<td>0.6%</td>
</tr>
<tr>
<td>≥2 FGIDs</td>
<td>10.5%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

* Controls with FGIDs at follow-up were excluded from further analyses.
with the control group (Lifetime: 4% vs 0%; Current: 3% vs 0%). Lifetime rates of substance abuse/dependence also were higher in FAP than in controls (17.5% vs 8.8%). However, group differences in somatoform and substance abuse/dependence were not significant in logistic regression analyses that controlled for age and gender. Rates of other disorders were low and did not differ significantly by group.

Age of Onset of Psychiatric Disorders and Temporal Relation to FAP Evaluation

Among participants who met criteria for a lifetime anxiety disorder (FAP, n = 170; control, n = 30), the age of onset was in childhood and did not differ significantly for FAP (M = 7.78 years, SD = 5.19) compared with controls (M = 8.97 years, SD = 5.98). The onset of depressive disorders was during adolescence and also did not differ by group (FAP, M = 15.96 years, SD = 4.61; control, M = 14.92 years, SD = 3.76).

Among FAP participants with a lifetime anxiety disorder, the majority (72.62%) reported onset before the age of their FAP evaluation. Among those with a lifetime depressive disorder, the majority (77.27%) reported onset after the age of their FAP evaluation.

Relation of Anxiety and Depressive Disorders to FGID at Follow-up

We subdivided participants in the FAP group into those who met Rome III criteria for an FGID at follow-up (FGID-POS; n = 133, 40.1%) and those who did not meet criteria at follow-up (FGID-NEG; n = 199; 59.9%). Figure 1 shows the risk of lifetime and current anxiety and depressive disorders in the FGID-POS, FGID-NEG, and control groups. Nearly two-thirds of the FGID-POS group (63.9%) met criteria for one or more lifetime anxiety disorders. The FGID-NEG group also had high rates of lifetime anxiety disorders (42.7%)

### TABLE 2

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Lifetime FAP (n = 332)</th>
<th>Controls (n = 147)</th>
<th>p</th>
<th>Current FAP (n = 332)</th>
<th>Controls (n = 147)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anxiety disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any anxiety disorder</td>
<td>170</td>
<td>51.20%</td>
<td>.001</td>
<td>101</td>
<td>30.42%</td>
<td>.001</td>
</tr>
<tr>
<td>Separation anxiety</td>
<td>97</td>
<td>9.34%</td>
<td></td>
<td>2</td>
<td>0.60%</td>
<td>.001</td>
</tr>
<tr>
<td>Panic</td>
<td>23</td>
<td>6.83%</td>
<td>.06</td>
<td>11</td>
<td>3.31%</td>
<td>.08</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>2</td>
<td>0.60%</td>
<td>.001</td>
<td>2</td>
<td>0.60%</td>
<td>.001</td>
</tr>
<tr>
<td>Social anxiety</td>
<td>86</td>
<td>25.90%</td>
<td>.001</td>
<td>40</td>
<td>12.05%</td>
<td>.001</td>
</tr>
<tr>
<td>Generalized anxiety</td>
<td>59</td>
<td>17.77%</td>
<td>.001</td>
<td>44</td>
<td>13.25%</td>
<td>.001</td>
</tr>
<tr>
<td>Obsessive-compulsive disorder</td>
<td>13</td>
<td>3.92%</td>
<td>1.00</td>
<td>9</td>
<td>2.71%</td>
<td>1.00</td>
</tr>
<tr>
<td>Specific phobia</td>
<td>46</td>
<td>13.86%</td>
<td>.02</td>
<td>27</td>
<td>8.13%</td>
<td>1.00</td>
</tr>
<tr>
<td>Posttraumatic stress disorder</td>
<td>31</td>
<td>9.34%</td>
<td>.12</td>
<td>8</td>
<td>2.41%</td>
<td>.21</td>
</tr>
<tr>
<td>Acute stress</td>
<td>0</td>
<td>0.00%</td>
<td>.99</td>
<td>0</td>
<td>0.00%</td>
<td>.99</td>
</tr>
<tr>
<td>Anxiety NOS</td>
<td>7</td>
<td>2.11%</td>
<td></td>
<td>4</td>
<td>1.20%</td>
<td>.95</td>
</tr>
<tr>
<td><strong>Depressive disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any depressive disorder</td>
<td>133</td>
<td>40.06%</td>
<td>.001</td>
<td>20</td>
<td>6.02%</td>
<td>.23</td>
</tr>
<tr>
<td>Major depressive disorder</td>
<td>120</td>
<td>36.14%</td>
<td>.001</td>
<td>17</td>
<td>5.12%</td>
<td>.50</td>
</tr>
<tr>
<td>Dysthymia</td>
<td>14</td>
<td>4.22%</td>
<td>.22</td>
<td>3</td>
<td>0.90%</td>
<td>.51</td>
</tr>
<tr>
<td>Depression NOS</td>
<td>4</td>
<td>1.20%</td>
<td>.84</td>
<td>0</td>
<td>0.00%</td>
<td>.00</td>
</tr>
<tr>
<td><strong>Other disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mania</td>
<td>5</td>
<td>1.51%</td>
<td>1.00</td>
<td>1</td>
<td>0.30%</td>
<td>1.00</td>
</tr>
<tr>
<td>Somatoform</td>
<td>14</td>
<td>4.22%</td>
<td>1.00</td>
<td>12</td>
<td>3.61%</td>
<td>1.00</td>
</tr>
<tr>
<td>Substance abuse/dependence</td>
<td>18</td>
<td>17.47%</td>
<td>.15</td>
<td>14</td>
<td>4.22%</td>
<td>.11</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>17</td>
<td>5.12%</td>
<td>.97</td>
<td>2</td>
<td>0.60%</td>
<td>.89</td>
</tr>
<tr>
<td>Disruptive behavior</td>
<td>25</td>
<td>7.53%</td>
<td>.17</td>
<td>8</td>
<td>2.41%</td>
<td>.11</td>
</tr>
</tbody>
</table>

Significance level (p) is for logistic regression controlling for gender and age at follow-up. NOS, not otherwise specified.

### TABLE 3

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>b</th>
<th>SE</th>
<th>Wald</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anxiety disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any anxiety disorder—lifetime</td>
<td>1.52***</td>
<td>0.25</td>
<td>23.91</td>
<td>5.78</td>
<td>2.56–12.53</td>
</tr>
<tr>
<td>FAP vs control subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any anxiety disorder—current at follow-up</td>
<td>1.27***</td>
<td>0.30</td>
<td>18.59</td>
<td>5.87</td>
<td>2.20–15.93</td>
</tr>
<tr>
<td>FAP vs control subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depressive disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any depressive disorder—lifetime</td>
<td>0.96***</td>
<td>0.26</td>
<td>13.33</td>
<td>2.62</td>
<td>1.56–4.62</td>
</tr>
<tr>
<td>FAP vs control subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any depressive disorder—Current at follow-up</td>
<td>0.68</td>
<td>0.58</td>
<td>1.41</td>
<td>1.98</td>
<td>0.64–6.12</td>
</tr>
<tr>
<td>FAP vs control subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** p < .001.
compared with the control group (20.4%). ORs with 95% CIs are presented in Table 4. Controlling for age and gender, the OR for any lifetime anxiety disorder was 7.31 times greater for FGID-POS compared with controls and 3.36 times greater for FGID-NEG compared with controls ($P < .001$). Current anxiety disorders also were more common in the FGID-POS group (39.9%) at follow-up compared with the FGID-NEG (24.12%) and control (11.6%) groups. Specifically, the OR for any current anxiety disorder was 5.08 times greater for FGID-POS compared with controls ($P < .001$) and 2.68 times greater for FGID-NEG compared with controls ($P < .05$).

Regarding depressive disorders, approximately half of FGID-POS (51.9%) and a third of FGID-NEG (32.2%) met criteria for a lifetime depressive disorder compared with 16.3% of controls. Controlling for age and gender, the OR for a lifetime depressive disorder was 4.14 times greater for FGID-POS compared with controls ($P < .001$) and 1.84 times greater for FGID-NEG compared with controls ($P < .05$).

DISCUSSION

We found a high risk for anxiety disorders at follow-up in pediatric patients with FAP followed prospectively from childhood into adolescence and young adulthood. The data are particularly compelling in that they reflect clinically significant disorders based on clinicians’ judgment that severity or impairment was moderate to high. By the time of follow-up in adolescence and young adulthood, half (51%) of those with a childhood history of FAP had met criteria for an anxiety disorder during their lifetime, and approximately one-third (30%) currently met criteria for an anxiety disorder. In contrast, only one-fifth (20%) of control participants met criteria for an anxiety disorder during their lifetime, and even fewer (12%) met criteria for current anxiety disorder at follow-up. Within the FAP group, risk for anxiety disorder was higher in those who met Rome III criteria at follow-up for FGID compared with those without FGID at follow-up. Nonetheless, even those without FGID at follow-up had significantly higher risk for anxiety disorder compared with controls. Thus, anxiety in patients with pediatric-onset FAP persisted over time even in the absence of abdominal pain associated with FGID.

For the majority of the FAP group, diagnostic interviews placed the onset of anxiety disorders before the pediatric gastroenterology evaluation that coincided with their enrollment in the study. Because they already had abdominal pain before their pediatric evaluation, the temporal relation between the onset of FAP and the onset of anxiety cannot be determined from these data. Nonetheless, both FAP and anxiety appear to have begun early in childhood. Interestingly, a recent study of children...
with anxiety disorders reported that 41% had symptoms of FGID compared with 6% of children without anxiety disorders. It is possible that FAP and anxiety share a common vulnerability such as a genetic variant that influences both pain sensitivity and psychological distress. Recent work also links low-grade inflammation to gastrointestinal symptoms as well as to anxiety. It also is possible that anxiety may arise secondary to pain in some individuals and yet serve a maintaining role in pain.

The association between FAP and anxiety can be understood within a biopsychosocial framework that recognizes the importance of emotional and social contextual processes in the experience of pain. Anxiety can alter pain sensitivity by increasing vigilance to potential threat, influencing pain coping, and disrupting endogenous opioid pain-control systems. Selective attention to pain-related information and a low threshold for alarm may lead patients with FAP to attend to minor discomfort and withdraw from activities, thereby potentially exacerbating their emotional distress. Abdominal pain also may legitimate children’s absence from school and other activities; parents may try to protect their child with FAP from settings associated with pain. Without such exposure, however, children lack opportunities to learn to cope effectively with both pain and anxiety. Social anxiety, which was common in individuals with a history of FAP, may be particularly insidious in driving a fear-avoidance cycle of pain that can maintain withdrawal from social settings in which pain had been experienced previously.

Regarding depressive disorders, lifetime risk was significantly higher in individuals with a history of FAP compared with controls (40% vs 16%), but, in contrast to anxiety disorders, depressive disorders were more likely to have developed subsequent to the medical evaluation for FAP. Current depressive disorders were rare at follow-up, however, and did not differ between individuals with a history of FAP and control subjects. Campo and colleagues similarly found that mood disorders were not significantly elevated in young adults with a history of FAP. Nonetheless, it is possible that pediatric FAP is associated with increased risk of depressive disorders, but because depression has a later onset and a more episodic course than anxiety disorders, we did not detect increased risk at the single, snapshot evaluation conducted in adolescence or early adulthood.

Risk of somatoform disorders was low and, after controlling for age and gender, did not differentiate the FAP and control groups. The DSM-IV criteria for somatoform disorders have shortcomings and may be replaced by a category of “somatic symptom disorders”; the proposed new diagnostic criteria may better distinguish individuals with and without a history of FAP.

Patients with FAP were enrolled in this study at the time of their evaluation at a tertiary care center. This ensured that all patients underwent a comprehensive subspecialty evaluation to rule out significant underlying organic disease but also represents a study limitation in that findings cannot generalize to children evaluated in primary care settings. A recent review reported that abdominal pain outcomes were similar in patients with and without a tertiary care evaluation, but no comparable data are available regarding psychological outcomes. It also should be noted that the age range at follow-up spanned adolescence and young adulthood and that the risk for some psychiatric disorders, such as depression, increases with age. This limitation was mitigated in part by controlling for age at follow-up in all analyses.

**CONCLUSIONS**

This study extends the literature linking pediatric FAP to anxiety disorders with prospective data showing that patients with FAP continue to experience high rates of anxiety disorders into adolescence and young adulthood. Patients with FAP also had high rates of depressive disorders during their lifetime, but few met criteria for a depressive disorder at the time of follow-up. This is the first study of pediatric FAP to integrate mental health and abdominal

### TABLE 4 ORs From Logistic Regression Analyses Comparing Risk of Lifetime and Current Diagnoses of Anxiety and Depressive Disorders for FAP With FGID (FGID-POS; n = 133) and Without FGID (FGID-NEG; n = 199) at Follow-Up Versus Control Subjects (n = 147)

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>Wald</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anxiety disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any anxiety disorder—lifetime</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FGID-POS vs control subjects</td>
<td>1.99***</td>
<td>0.29</td>
<td>48.31</td>
<td>7.31</td>
<td>4.17–12.81</td>
</tr>
<tr>
<td>FGID-NEG vs control subjects</td>
<td>1.21***</td>
<td>0.26</td>
<td>21.22</td>
<td>3.36</td>
<td>2.01–5.63</td>
</tr>
<tr>
<td>Any anxiety disorder—current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FGID-POS vs control subjects</td>
<td>1.63***</td>
<td>0.32</td>
<td>25.32</td>
<td>5.09</td>
<td>2.70–9.59</td>
</tr>
<tr>
<td>FGID-NEG vs control subjects</td>
<td>0.99**</td>
<td>0.32</td>
<td>9.68</td>
<td>2.68</td>
<td>1.44–4.99</td>
</tr>
<tr>
<td><strong>Depressive disorders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Depressive Disorder - Lifetime</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FGID-POS vs control subjects</td>
<td>1.42***</td>
<td>0.30</td>
<td>22.90</td>
<td>4.14</td>
<td>2.31–7.40</td>
</tr>
<tr>
<td>FGID-NEG vs control subjects</td>
<td>0.61*</td>
<td>0.30</td>
<td>4.49</td>
<td>1.84</td>
<td>1.05–3.25</td>
</tr>
<tr>
<td>Any depressive disorder—current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FGID-POS vs control subjects</td>
<td>0.76</td>
<td>0.63</td>
<td>1.44</td>
<td>2.13</td>
<td>0.62–7.34</td>
</tr>
<tr>
<td>FGID-NEG vs control subjects</td>
<td>0.63</td>
<td>0.61</td>
<td>1.05</td>
<td>1.87</td>
<td>0.57–6.22</td>
</tr>
</tbody>
</table>

Analyses adjusted for gender and age at follow-up. *P < .05; **P < .01; ***P < .001.
pain outcomes. Notably, even individuals with a childhood history of FAP who did not meet FGID symptom criteria at follow-up still had significantly higher rates of anxiety disorders compared with controls. Social anxiety disorder was particularly common in the pediatric FAP patients and may contribute to school absence and withdrawal from social activities, thereby perpetuating pain-related disability.51

A decade after the seminal work by Campo et al,13 these data underscore the importance of a biopsychosocial approach to FAP that includes screening for anxiety and depression. Future research should evaluate whether interventions that treat mental health problems in FAP improve abdominal pain outcomes.

ACKNOWLEDGMENTS

We thank those who served as psychiatric diagnostic interviewers for this study, including Hollister Trott, Mary Payne, and Shelly Ball.

REFERENCES

27. Hollingshead A. Four Factor Index of Social Status. New Haven, CT: Yale University; 1975


44. Lether J, Slade PD, Troup JD, Bentley G. Outline of a fear-avoidance model of exaggerated pain perception—II. Behav Res Ther. 1983;21(4):401–408


(Continued from first page)

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by grant RO1 HD23264 (L.S. Walker, principal investigator) from the National Institute on Child Health and Development and does not represent official views of the Institute. Support was also provided by Vanderbilt Kennedy Center (grant P30 HD15052), Vanderbilt Digestive Disease Research Center (grant DK058404), and the Vanderbilt CTSA (grant 1 UL1 RR024975) from the National Center for Research Resources, National Institutes of Health. Grace Shelby was supported in part by a training grant from the National Institutes of Mental Health (grant T32-MH18921). Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.
Functional Abdominal Pain in Childhood and Long-term Vulnerability to Anxiety Disorders
Grace D. Shelby, Kezia C. Shirkey, Amanda L. Sherman, Joy E. Beck, Kirsten Haman, Angela R. Shears, Sara N. Horst, Craig A. Smith, Judy Garber and Lynn S. Walker

Pediatrics 2013;132;475; originally published online August 12, 2013; DOI: 10.1542/peds.2012-2191

Updated Information & Services
including high resolution figures, can be found at:
/content/132/3/475.full.html

References
This article cites 46 articles, 5 of which can be accessed free at:
/content/132/3/475.full.html#ref-list-1

Citations
This article has been cited by 5 HighWire-hosted articles:
/content/132/3/475.full.html#related-urls

Post-Publication Peer Reviews (P3Rs)
One P3R has been posted to this article:
/cgi/eletters/132/3/475

Subspecialty Collections
This article, along with others on similar topics, appears in the following collection(s):
Gastroenterology
/cgi/collection/gastroenterology_sub
Abdominal Pain
/cgi/collection/abdominal_pain_sub
Psychiatry/Psychology
/cgi/collection/psychiatry_psychology_sub

Permissions & Licensing
Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
/site/misc/Permissions.xhtml

Reprints
Information about ordering reprints can be found online:
/site/misc/reprints.xhtml

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2013 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.
Functional Abdominal Pain in Childhood and Long-term Vulnerability to Anxiety Disorders
Grace D. Shelby, Kezia C. Shirkey, Amanda L. Shears, Sara N. Horst, Craig A. Smith, Judy Garber and Lynn S. Walker

Pediatrics 2013;132;475; originally published online August 12, 2013;
DOI: 10.1542/peds.2012-2191

The online version of this article, along with updated information and services, is located on the World Wide Web at:
/content/132/3/475.full.html