Epidemiological and pathophysiological aspects of abdominal pain predominant functional gastrointestinal disorders in children and adolescents: a Sri Lankan perspective
Devanarayana, N.M.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Chapter 3

Abdominal pain-predominant functional gastrointestinal disorders in children and adolescents: prevalence, symptomatology and association with emotional stress

This chapter of the thesis was published as

ABSTRACT

Background and objectives: Functional gastrointestinal disorders (FGIDs) are common among children, but little is known regarding their prevalence in developing countries. We assessed the prevalence of abdominal pain predominant FGIDs in addition to the predisposing factors and symptomatology, in Sri Lankan children.

Patients and Methods: A cross-sectional survey was conducted among a randomly selected group of 10- to 16-year-olds in 8 randomly selected schools in 4 provinces in Sri Lanka. A validated, self-administered questionnaire was completed by children independently in an examination setting. FGIDs were diagnosed using Rome III criteria.

Results: A total of 2180 questionnaires were distributed and 2163 (99.2%) were included in the analysis (1189 [55%] boys, mean age 13.4 years, standard deviation 1.8 years). Of them, 270 (12.5%) had at least one abdominal pain-predominant FGIDs. Irritable bowel syndrome (IBS) was seen in 107 (4.9%), functional dyspepsia in 54 (2.5%), functional abdominal pain in 96 (4.4%) and abdominal migraine (AM) in 21 (1.0%) (2 had AM and functional dyspepsia, 6 had AM and IBS). Extraintestinal symptoms were more common among affected children (p<0.05). Abdominal pain-predominant FGIDs were higher in girls and those exposed to stressful events (p<0.05). Prevalence negatively correlated with age (r= -0.05, p=0.02).

Conclusion: Abdominal pain-predominant FGIDs affects 12.5% of children aged 10 to 16 years and constitutes a significant health problem in Sri Lanka. IBS is the most common FGID type present. Abdominal pain-predominant FGIDs were higher in girls and those exposed to emotional stress. Prevalence of FGIDs decreased with age. Extraintestinal symptoms are more frequent in affected children.
INTRODUCTION
Chronic or recurrent abdominal pain (RAP) is a global health problem affecting 10% to 12% of children and adolescents.1-3 The majority of them have abdominal pain-predominant functional gastrointestinal diseases (AP-FGIDs) and < 25% have organic causes for their symptoms.4,5 The main abdominal pain predominant FGIDs, defined in the Rome III criteria, are functional dyspepsia (FD), irritable bowel syndrome (IBS), abdominal migraine (AM) and functional abdominal pain (FAP).6 Because the pathophysiology, clinical profile and management strategies vary with the subtype,7,8 it is important to classify chronic/recurrent abdominal pain into different etiologic categories.

Epidemiological studies are needed to identify the true burden of these disorders in the community because a significant percentage of patients with FGIDs do not seek health care.9,10 So far, the majority of studies on these disorders are hospital based.4,11,12 There are only a few epidemiological studies have been published in the world, and data published so far have reported AP-FGIDs in 13.8% of Asian children13 and 0.5% of Western children.14.

Pain characteristics, associated symptoms and bowel habits play a significant role in Rome III diagnostic criteria for AP-FGIDs.6 It is also suggested that other somatic symptoms such as headache, limb pain, and sleeping difficulty are more common in children15 and adults with IBS,16 but so far very few studies have assessed intestinal-related and extraintestinal symptoms associated with AP-FGIDs.

The exact etiology of FGIDs is not fully understood. The symptoms cannot be explained by the traditional biomedical models. The new biopsychosocial model suggests that these disorders originate from simultaneous interactions among biological, social and psychological factors.17 Biological factors including familial predisposition,5 sociocultural factors including lower socioeconomic status18 and psychological factors including emotional stress19 are known to be associated with FGIDs. The interplay between these risk factors needed to be studied in depth to understand the possible pathological processes involving FGIDs, especially in children.

The present study was conducted with the objectives of identifying the prevalence of different types of abdominal AP-FGIDs in Sri Lanka, clinical profile of the affected children, and social and psychological factors associated with these disorders.
PATIENTS AND METHODS

An island-wide, cross-sectional survey was conducted in 4 randomly selected provinces (out of 9 provinces) in Sri Lanka. From every selected province, 2 schools each (1 urban and 1 rural) were randomly selected. From every school, 12 classes each were randomly selected from academic years 6 to 12 (2 from each academic year). All the children present in the selected classes on the day of the survey were included in the study. School administration and parents were informed and consent to administer the questionnaire was obtained before conducting the study.

Data were collected using a pretested questionnaire that consisted of two parts. Part 1 included questions on sociodemographic and family factors and exposure to stressful life events. Part 2 is the Questionnaire on Pediatric Gastrointestinal Symptoms – Rome III version (self-reported form for children and adolescents, 10 years of age and older), translated into the native language and validated for Sri Lankan children. The questionnaire was administered in an examination setting to ensure confidentiality and privacy. Adequate time was given to each child to complete the questionnaire and research assistants were available during this period to clarify any question.

Children with abdominal pain were categorized into AP-FGIDs (FD, IBS, AM, and FAP) using Rome III criteria for childhood FGIDs. In this survey, we did not perform a physical examination on affected children.

Data were analyzed using $\chi^2$ and Fisher exact tests using EpiInfo (EpiInfo 6, version 6.04 (1996) Centres of Disease Control and Prevention, Atlanta, Georgia, USA and World Health Organization, Geneva, Switzerland). $P<0.05$ was taken as significant. Ethical approval for the present study was granted by the ethics committee of the Sri Lanka College of Pediatricians.

RESULTS

A total of 2180 questionnaires were distributed and all of them were returned. Of them, 2163 (99.2%) were included in the analysis (1189 [55%] boys, mean age 13.4 years, SD 1.8 years). Seventeen incompletely filled-out questionnaires were excluded from the analysis.

Prevalence of AP-FGIDs

According to Rome III criteria, 270 had at least 1 AP-FGIDs. (Table 3.1). Two children with AM also had FD and 6 with AM also had IBS. Of 96 children with FAP, 42 (43.8%) fulfilled criteria for functional abdominal pain syndrome (FAPS). IBS and FD were significantly common among girls
and so was the total AP-FGIDs. Figure 3.1 illustrates age-related predicted probability of having an AP-FGID. There was a negative correlation between prevalence of AP-FGIDs and age (correlation coefficient -0.05, 95% confidence interval (CI) -0.008 to -0.095, $P=0.02$).

**Table 3.1 – Prevalence of abdominal pain-predominant FGIDs according to sex**

<table>
<thead>
<tr>
<th>FGID type</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$ (%)</td>
<td>$n$ (%)</td>
<td>$n$ (%)</td>
</tr>
<tr>
<td><strong>FD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18 (1.5%)</td>
<td>36 (3.7%)</td>
<td>54 (2.5%)</td>
</tr>
<tr>
<td><strong>IBS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>43 (3.6%)</td>
<td>64 (6.6%)</td>
<td>107 (4.9%)</td>
</tr>
<tr>
<td><strong>AM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 (0.7%)</td>
<td>13 (1.3%)</td>
<td>21 (1.0%)</td>
</tr>
<tr>
<td><strong>FAP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44 (3.7%)</td>
<td>52 (5.3%)</td>
<td>96 (4.4%)</td>
</tr>
<tr>
<td><strong>Abdominal pain-predominant</strong></td>
<td>110 (9.3%)</td>
<td>160 (16.4%)</td>
<td>270 (12.5%)</td>
</tr>
</tbody>
</table>

* AM=abdominal migraine; FAP=functional abdominal pain; FD=functional dyspepsia; FGID=functional gastrointestinal disorder; IBS=irritable bowel syndrome
* Girls versus boy, $P<0.01$ (unpaired t-test)
† One also had AM, ‡ Two also had AM, § Four also had AM, ¶ Six also had AM

![Figure 3.1](image.png)

**Figure 3.1**– Mean predicted probability of developing abdominal pain predominant FGIDs according the age and sex (* $P<0.05$)
Association between sociodemographic characteristics and AP-FGIDs

A total of 1893 children without abdominal AP-FGIDs were identified as controls. **Table 3.2** demonstrates the association between the socioeconomic characteristics and AP-FGIDs. Socioeconomic characteristics were not significantly different between patients with AP-FGIDs and controls (P>0.05).

Pain characteristics in children with AP-FGIDs

**Table 3.3** demonstrates the distribution of pain characteristics of children with AP-FGIDs. The only characteristic that significantly differed between subtypes was the presence of severe abdominal pain, which was more common among children with AM (P<0.05).

Of 270 children with AP-FGIDs, 87 (32.2%) had disturbances in school attendance because of pain (FD 22 [40.7%], IBS 36 [33.6%], AM 7 [33.3%], and FAP 22 [22.9%]).

Intestinal and extraintestinal symptoms in affected children

Intestinal-related symptoms such as bloating, loss of appetite, nausea, vomiting, flatulence and burping and extraintestinal symptoms such as headache, limb pain, sleeping difficulty and photophobia were commoner among children with FGIDs compared to controls (P<0.05) (**Table 3.4**).

Association between stress and AP-FGIDs

**Table 3.5** shows the association between stressful life events and AP-FGIDs. After multiple logistic regression analysis, separation from best friend (adjusted odds ratio [OR] 1.5, 95% CI 1.1-2.1, P=0.017), failure in an examination [adjusted OR 1.7, 95% CI 1.0-2.6, P= 0.033], loss of parent’s job [adjusted OR 2.0, 95% CI 1.0-3.8, P= 0.039] and hospitalization of the child himself or herself for another illness [adjusted OR 1.6, 95% CI 1.0-2.4, P= 0.031] were independently associated with AP-FGIDs.
Table 3.2 – Demographic and family characteristics of children with abdominal pain-predominant FGIDs compared to controls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Abdominal pain-predominant FGIDs (n=270)</th>
<th>Controls (n=1893)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Family size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only child</td>
<td>27 (10.0)</td>
<td>146 (7.7)</td>
</tr>
<tr>
<td>2-3 children</td>
<td>230 (85.2)</td>
<td>1660 (87.7)</td>
</tr>
<tr>
<td>≥ 4 children</td>
<td>13 (4.8)</td>
<td>87 (4.6)</td>
</tr>
<tr>
<td>Birth order*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eldest</td>
<td>109 (44.9)</td>
<td>767 (43.9)</td>
</tr>
<tr>
<td>2nd child</td>
<td>89 (36.6)</td>
<td>568 (32.5)</td>
</tr>
<tr>
<td>3rd child</td>
<td>28 (11.5)</td>
<td>297 (17.0)</td>
</tr>
<tr>
<td>4th child or more</td>
<td>17 (7.0)</td>
<td>115 (6.6)</td>
</tr>
<tr>
<td>Maternal employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading profession (e.g., doctor, engineer)</td>
<td>7 (2.6)</td>
<td>43 (2.3)</td>
</tr>
<tr>
<td>Lesser profession (e.g., nurse, teacher)</td>
<td>8 (3.0)</td>
<td>119 (6.3)</td>
</tr>
<tr>
<td>Skilled non manual (e.g., clerk)</td>
<td>3 (1.1)</td>
<td>70 (3.7)</td>
</tr>
<tr>
<td>Skilled manual (e.g., mason, carpenter)</td>
<td>12 (4.4)</td>
<td>55 (2.9)</td>
</tr>
<tr>
<td>Unskilled/unemployed</td>
<td>240 (88.9)</td>
<td>1605 (84.8)</td>
</tr>
<tr>
<td>Mother not living</td>
<td>—</td>
<td>1 (0.0)</td>
</tr>
<tr>
<td>Father’s social class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading profession</td>
<td>43 (15.9)</td>
<td>270 (14.3)</td>
</tr>
<tr>
<td>Lesser profession</td>
<td>10 (3.7)</td>
<td>109 (5.8)</td>
</tr>
<tr>
<td>Skilled non manual</td>
<td>49 (18.1)</td>
<td>343 (18.1)</td>
</tr>
<tr>
<td>Skilled manual</td>
<td>113 (41.9)</td>
<td>795 (42.0)</td>
</tr>
<tr>
<td>Unskilled/unemployed</td>
<td>50 (18.5)</td>
<td>355 (18.8)</td>
</tr>
<tr>
<td>Father not living</td>
<td>5 (1.9)</td>
<td>21 (1.1)</td>
</tr>
<tr>
<td>Location of school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>192 (71.1)</td>
<td>1390 (73.4)</td>
</tr>
<tr>
<td>Rural</td>
<td>78 (28.9)</td>
<td>503 (26.6)</td>
</tr>
</tbody>
</table>

FGIDs = functional gastrointestinal disorders, *Families with more than one child

$P>0.05$ for all comparisons between patients and controls (unpaired t test)
<table>
<thead>
<tr>
<th>Frequency of pain</th>
<th>FD†</th>
<th>IBS‡</th>
<th>AM</th>
<th>FAP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Once per month</td>
<td>0</td>
<td>0</td>
<td>3 (14.3)</td>
<td>0</td>
<td>3 (1.1)</td>
</tr>
<tr>
<td>Once per week</td>
<td>21 (38.9)</td>
<td>44 (41.1)</td>
<td>8 (38.1)</td>
<td>52 (54.2)</td>
<td>124 (45.9)</td>
</tr>
<tr>
<td>Several times per week</td>
<td>29 (53.7)</td>
<td>58 (54.2)</td>
<td>10 (47.6)</td>
<td>41 (42.7)</td>
<td>132 (48.9)</td>
</tr>
<tr>
<td>Everyday</td>
<td>4 (7.4)</td>
<td>5 (4.7)</td>
<td>0</td>
<td>3 (3.1)</td>
<td>11 (4.1)</td>
</tr>
<tr>
<td></td>
<td>14 (25.9)</td>
<td>16 (15.0)</td>
<td>4 (19.0)</td>
<td>13 (13.6)</td>
<td>45 (16.7)</td>
</tr>
<tr>
<td>Duration of pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 months</td>
<td>16 (29.6)</td>
<td>31 (29.0)</td>
<td>0</td>
<td>38 (59.4)</td>
<td>85 (31.5)</td>
</tr>
<tr>
<td>3 months</td>
<td>14 (25.9)</td>
<td>13 (12.1)</td>
<td>4 (19.0)</td>
<td>25 (26.0)</td>
<td>54 (20.0)</td>
</tr>
<tr>
<td>4-11 months</td>
<td>10 (18.6)</td>
<td>47 (43.9)</td>
<td>13 (61.9)</td>
<td>20 (20.8)</td>
<td>86 (31.9)</td>
</tr>
<tr>
<td>≥ 12 months</td>
<td>14 (25.9)</td>
<td>16 (15.0)</td>
<td>4 (19.0)</td>
<td>13 (13.6)</td>
<td>45 (16.7)</td>
</tr>
<tr>
<td>Duration of pain episodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>37 (68.5)</td>
<td>59 (55.1)</td>
<td>0</td>
<td>68 (70.8)</td>
<td>164 (60.7)</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>8 (14.8)</td>
<td>31 (29.0)</td>
<td>10 (47.6)</td>
<td>12 (12.5)</td>
<td>56 (20.7)</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>4 (7.4)</td>
<td>8 (7.5)</td>
<td>2 (9.5)</td>
<td>6 (6.3)</td>
<td>20 (7.4)</td>
</tr>
<tr>
<td>Most of the day</td>
<td>5 (9.3)</td>
<td>9 (8.4)</td>
<td>9 (42.9)</td>
<td>10 (10.4)</td>
<td>30 (11.1)</td>
</tr>
<tr>
<td>Severity of pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>11 (20.4)</td>
<td>20 (18.7)</td>
<td>0</td>
<td>26 (27.1)</td>
<td>57 (21.1)</td>
</tr>
<tr>
<td>Moderate</td>
<td>31 (57.4)</td>
<td>67 (62.6)</td>
<td>0</td>
<td>50 (52.1)</td>
<td>148 (54.8)</td>
</tr>
<tr>
<td>Severe</td>
<td>12 (22.2)</td>
<td>20 (18.7)</td>
<td>21 (100)*</td>
<td>20 (20.1)</td>
<td>65 (24.1)</td>
</tr>
<tr>
<td>Location of pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper abdomen</td>
<td>54 (100)</td>
<td>26 (24.3)</td>
<td>8 (27.6)</td>
<td>0</td>
<td>86 (31.9)</td>
</tr>
<tr>
<td>Periumbilical/lower abdomen</td>
<td>0</td>
<td>50 (46.7)</td>
<td>13 (61.9)</td>
<td>70 (72.9)</td>
<td>127 (47.0)</td>
</tr>
<tr>
<td>Both upper and lower abdomen</td>
<td>0</td>
<td>31 (29.0)</td>
<td>0</td>
<td>26 (27.1)</td>
<td>57 (21.1)</td>
</tr>
</tbody>
</table>

AM = abdominal migraine; FAP = functional abdominal pain; FD = functional dyspepsia; FGIDs = functional gastrointestinal disorders; IBS = irritable bowel syndrome

* P<0.001, compared with other 3 types of FGIDs (unpaired t test)
† Two children had FD and AM.
‡ Six children had IBS and AM.
Table 3.4 – Intestinal-related and extraintestinal symptoms in children with abdominal pain-predominant FGIDs

<table>
<thead>
<tr>
<th>Symptom</th>
<th>FD n (%)</th>
<th>IBS n (%)</th>
<th>AM n (%)</th>
<th>FAP n (%)</th>
<th>FGID-total n (%)</th>
<th>Controls n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intestinal-related symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloating</td>
<td>19 (35.2)***</td>
<td>48 (44.9)***</td>
<td>9 (42.9)***</td>
<td>43 (44.8)***</td>
<td>115 (42.6)***</td>
<td>462 (24.4)</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>10 (18.5)***</td>
<td>31 (29.0)***</td>
<td>13 (61.9)***</td>
<td>21 (21.9)***</td>
<td>69 (25.6)***</td>
<td>101 (5.3)</td>
</tr>
<tr>
<td>Nausea</td>
<td>10 (18.5)***</td>
<td>31 (29.0)***</td>
<td>12 (57.1)***</td>
<td>25 (26.0)***</td>
<td>72 (26.7)***</td>
<td>70 (3.7)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>2 (3.7)***</td>
<td>17 (15.9)***</td>
<td>4 (19.0)***</td>
<td>2 (2.1)</td>
<td>24 (8.9)***</td>
<td>24 (1.3)</td>
</tr>
<tr>
<td>Flatulence</td>
<td>23 (42.6)***</td>
<td>67 (6.0)***</td>
<td>11 (52.4)***</td>
<td>51 (53.1)***</td>
<td>148 (54.8)***</td>
<td>369 (19.5)</td>
</tr>
<tr>
<td>Burping</td>
<td>40 (74.1)*</td>
<td>72 (67.3)***</td>
<td>16 (76.2)*</td>
<td>65 (67.7)</td>
<td>187(69.3)***</td>
<td>414 (21.9)</td>
</tr>
<tr>
<td><strong>Extra-intestinal symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>11 (20.4)***</td>
<td>47 (43.9)***</td>
<td>16 (76.2)***</td>
<td>31 (32.3)***</td>
<td>99 (36.7)***</td>
<td>92 (4.7)</td>
</tr>
<tr>
<td>Sleeping difficulty</td>
<td>17 (31.5)***</td>
<td>65 (60.7)***</td>
<td>11 (52.4)***</td>
<td>37 (38.5)***</td>
<td>127 (47.0)***</td>
<td>125 (6.6)</td>
</tr>
<tr>
<td>Limb pain</td>
<td>15 (27.8)***</td>
<td>53 (49.5)***</td>
<td>15 (71.4)***</td>
<td>34 (35.4)***</td>
<td>110 (40.7)***</td>
<td>108 (5.7)</td>
</tr>
<tr>
<td>Photophobia</td>
<td>4 (7.4)***</td>
<td>29 (27.1)***</td>
<td>12 (57.1)***</td>
<td>15 (15.6)***</td>
<td>55 (20.4)***</td>
<td>38 (2.0)</td>
</tr>
<tr>
<td>Light-headed</td>
<td>10 (18.5)</td>
<td>46 (43.0)</td>
<td>13 (61.9)</td>
<td>29 (30.2)</td>
<td>94 (34.8)</td>
<td>75 (4.0)</td>
</tr>
</tbody>
</table>

AM = abdominal migraine; FAP = functional abdominal pain; FD = functional dyspepsia; FGIDs = functional gastrointestinal disorders; IBS = irritable bowel syndrome

*p<0.05, **p<0.001, ***p<0.0001, compared with controls (unpaired t test)
Table 3.5 - Distribution of responders according to exposure to stressful life events

<table>
<thead>
<tr>
<th>Stressful event</th>
<th>FGIxDs</th>
<th>Controls</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in school</td>
<td>10 (3.7)</td>
<td>80 (4.2)</td>
<td>0.81 (0.4-1.7)</td>
<td>0.81</td>
</tr>
<tr>
<td>Suspension from school</td>
<td>3 (1.1)</td>
<td>7 (0.4)</td>
<td>3.03 (0.62-13.03)</td>
<td>0.12</td>
</tr>
<tr>
<td>Frequent punishment in school</td>
<td>14 (5.2)</td>
<td>76 (4.0)</td>
<td>1.31 (0.7-2.42)</td>
<td>0.46</td>
</tr>
<tr>
<td>Separation from best friend</td>
<td>62 (23.0)</td>
<td>62 (3.3)</td>
<td>1.63 (1.18-2.25)</td>
<td>0.002</td>
</tr>
<tr>
<td>Sitting for government examination</td>
<td>124 (45.9)</td>
<td>711 (37.6)</td>
<td>1.41 (1.08-1.84)</td>
<td>0.01</td>
</tr>
<tr>
<td>Failure in an examination</td>
<td>30 (11.1)</td>
<td>110 (5.8)</td>
<td>2.03 (1.29-3.16)</td>
<td>0.014</td>
</tr>
<tr>
<td>Being bullied at school</td>
<td>14 (5.2)</td>
<td>75 (4.0)</td>
<td>1.33 (0.71-2.45)</td>
<td>0.43</td>
</tr>
<tr>
<td>Severe illness in a close family member</td>
<td>49 (18.1)</td>
<td>272 (14.4)</td>
<td>1.32 (0.93-1.87)</td>
<td>0.12</td>
</tr>
<tr>
<td>Death of a close family member</td>
<td>33 (12.2)</td>
<td>146 (7.7)</td>
<td>1.67 (1.09-2.53)</td>
<td>0.016</td>
</tr>
<tr>
<td>Loss of a parent's job</td>
<td>14 (5.2)</td>
<td>45 (2.4)</td>
<td>2.25 (1.16-4.29)</td>
<td>0.014</td>
</tr>
<tr>
<td>Divorce or separation of parents</td>
<td>2 (0.7)</td>
<td>17 (0.9)</td>
<td>0.82 (0.13-3.73)</td>
<td>0.93</td>
</tr>
<tr>
<td>Birth of a sibling</td>
<td>25 (9.3)</td>
<td>129 (6.8)</td>
<td>1.40 (0.87-2.23)</td>
<td>0.18</td>
</tr>
<tr>
<td>Frequent domestic fights</td>
<td>15 (5.6)</td>
<td>55 (2.9)</td>
<td>1.97 (1.05-6.64)</td>
<td>0.034</td>
</tr>
<tr>
<td>Frequent punishment by the parents</td>
<td>18 (6.7)</td>
<td>72 (3.8)</td>
<td>1.81 (1.02-3.16)</td>
<td>0.041</td>
</tr>
<tr>
<td>Father's alcoholism</td>
<td>17 (6.3)</td>
<td>85 (4.5)</td>
<td>1.43 (0.8-2.51)</td>
<td>0.25</td>
</tr>
<tr>
<td>Hospitalization of the child for other illness</td>
<td>44 (16.3)</td>
<td>180 (9.5)</td>
<td>1.85 (1.27-2.69)</td>
<td>0.0009</td>
</tr>
<tr>
<td>Exposure to at least 1 stressful event</td>
<td>198 (73.3)</td>
<td>1190 (62.8)</td>
<td>1.63 (1.21-2.19)</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

CI = confidence interval; FGIxDs = Functional gastrointestinal disorders; OR = odds ratio.
DISCUSSION

Community-based studies to assess the burden of AP-FGIDs in children are rare. In the present epidemiological survey we demonstrated that 12.5% of native Sri Lankan children had at least one AP-FGID. IBS was the most prevalent FGID, followed by FAP and FD. There was a negative correlation between the prevalence of AP-FGIDs and age. Intestinal-related and extraintestinal symptoms were more common in children with all 4 types of abdominal pain-predominant FGIDs compared to controls. There was a significant association between exposure to stressful life events and presence of an AP-FGID.

Prevalence of FGIDs depends on several factors. Of them, the definition used in the diagnosis is one of the main determinants. A previous school-based study in children ages 10 to 16 years, using Rome III criteria, has shown IBS as the most common FGID followed by FD and FAP. In contrast, another study using Rome II criteria has shown FD as the most common AP-FGID. Inclusion of children of different age groups and differences in diagnostic criteria and methods of data collection could have contributed to this difference. One percent of the children in our study had AM, lower than the previous study that found AM in 3% of schoolchildren. Another study from the United Kingdom, using different criteria, has shown AM in 4.1%. These differences of prevalence may result from small sample size and disparity of definitions. The prevalence of FAP in our sample is comparable to that previously reported in Sri Lanka. FAPS is a newly described entity in Rome III process and indicates significant loss of daily function or having somatic symptoms. Forty-three percent of children with FAP had FAPS. Helgeland et al. have shown that nearly 60% of children with FAP had FAPS. Children referred to a secondary-care hospital would be more likely to have somatic symptoms and disruption of daily activities than a community sample and this probably explains the difference between the 2 studies.

In our sample, at all ages, girls had a significantly higher probability of having an AP-FGID. We found that FD and IBS were significantly more common among girls. Similar to our results, a previous study conducted in children with abdominal pain has shown higher prevalence in girls. One hospital-based study on children with dyspepsia and 3 studies in children with IBS, failed to show a significant sex difference. Our findings are compatible with findings of adult studies from Western countries, which have shown that girls have a higher tendency to develop IBS. Heitkemper and Jarrett have previously suggested the difference in hormonal profiles in girls and boys as a contributory factor for higher prevalence of IBS in women; however, in our sample, this sex difference was significant even in young girls (10-11 years) in whom the majority have not attained menarche and do not have the full hormonal profile of women. Therefore, we believe that the sex difference in the prevalence of IBS predates the
effects of reproductive hormones. This observed sex difference may result from differences in pain perception between boys and girls. Visceral hypersensitivity plays an important role in the pathogenesis of AP-FGIDs in children.\textsuperscript{26,27} A study comparing children with FAP and IBS has found a higher rectal hypersensitivity in girls than in boys.\textsuperscript{28} Adult studies have also shown similar results.\textsuperscript{29} Therefore, it is possible that the heightened visceral sensitivity in girls predisposes them to be more likely to manifest IBS. We failed to demonstrate a significant sex difference in AM. This is similar to the findings of Abu-Arafeh and Russell.\textsuperscript{21}

The prevalence of AP-FGIDs declined with age in both boys and girls. The reason for this phenomenon is unclear. We previously reported a similar age-related decline in the prevalence of functional defecation disorders such as constipation\textsuperscript{30} and fecal incontinence.\textsuperscript{18}

There are conflicting data on the association between socioeconomic factors and AP-FGIDs. Previous studies in adults have shown that an affluent childhood living conditions is associated with IBS.\textsuperscript{31,32} Similarly, adult studies in Asia (China, Singapore) have shown that the prevalence of IBS is higher among people who have achieved higher educational status.\textsuperscript{33,34} In contrast, Drossman \textit{et al.}\textsuperscript{35} noted that functional bowel diseases are more common in households with low incomes. Based on these data, in the present study we hypothesized that socioeconomic factors play a significant role in the development of FGIDs in children. In contrast to our hypothesis, we did not find a significant association between FGIDs and social class. Similar to our results, other studies in children with IBS\textsuperscript{15} and recurrent abdominal pain\textsuperscript{2,36} have failed to demonstrate such an association. Therefore, it is possible that social factors may play an inconsequential role in the causation of AP-FGIDs in children. Psychological factors such as emotional stress and biological factors such as heightened visceral sensitivity\textsuperscript{37} and abnormal motility\textsuperscript{38} probably play a more significant part in the pathogenesis of these disorders.

In our study, most intestinal-related symptoms (bloating, loss of appetite, nausea, vomiting, flatus and burping) were more common in FD, IBS, FAP and AM compared with controls. Previous studies have shown that bloating is a significant problem in children\textsuperscript{24} and adults\textsuperscript{39} with IBS. Furthermore, bloating correlated with patient-perceived severity of IBS.\textsuperscript{40} However, association of these features with other AP-FGIDs such as FD, AM and FAP has not been described in children in the past. Delayed gastric emptying and abnormal antral motility have been reported in children with all four types of AP-FGIDs.\textsuperscript{41} Gastrointestinal motility dysfunctions may have contributed to abnormal gas dynamics and, therefore, to increased flatulence and burping noted in our patients. Further studies involving children with AP-FGIDs would help to explore this possibility. In the present study, loss of appetite and nausea were less
prevalent in children with FD than in other 3 types of FGIDs. Comparable to our results, a previous study using Rome II criteria has demonstrated early satiety in <10% of children with functional dyspepsia; however, in the same study, nausea is seen in approximately 70% of children with FD, significantly higher than in our sample. The previous study was conducted in a tertiary-care gastroenterology unit, whereas our study was a school survey. Differences in patient selection and variation in genetic and environmental factors must have influenced the different results observed in two studies between two communities may have caused this difference.

Pain characteristics of FD, IBS, FAP and AM in our sample behaved as per definition. All of the children with FD had pain in the upper abdomen, 7% had daily symptoms, and only 22% had severe pain. In contrast to this, a hospital-based study by Hyams et al. reported daily symptoms in the majority (69%). Furthermore, in our sample, only 4.7% of children with IBS had daily symptoms and most of them had pain duration of <1 hour. Compared with these findings, a hospital-based study in United States in children ages 5 to 17 years noted that 60% of them have daily symptoms, with 34% having pain duration of > 1 hour. It is possible that children in our community-based sample have less severe pain and lower pain duration compared with both of these hospital-based studies. Severity of the pain is one of the significant determinants of health care seeking. Therefore, children with a higher frequency of pain would seek health care more frequently and are more likely to be included in hospital-based studies. The majority of children with AM in our study had pain in the lower abdomen or around the umbilicus. Abu-Arafeh and Russell noted that 78% of children with AM in their sample had periumbilical pain.

In our study, extraintestinal symptoms such as headache, difficulty in sleep, limb pains, limb pain, photophobia and feeling lightheaded were noted to occur more frequently in children with all 4 types of AP-FGIDs. Similar to our findings, Dong et al. have reported headaches and difficulty in sleeping more commonly in children with IBS. Another community-based study has found that adults with dyspepsia have significantly higher somatic symptom scores than controls. Extraintestinal somatic symptoms are an integrated part of FGIDs and contribute significantly to the severity of disease and quality of life. Therefore, it is important to seek these symptoms in the clinical evaluation of children because they may contribute to significant distress and poor quality of life.

Psychological stress plays a key role in initiating and precipitating FGIDs in susceptible individuals. Human and animal studies have shown that both psychological and physical
stresses can alter gastric motility and visceral sensitivity. In our study, school-related stressful life events such as separation from best friend and failure at an examination, family-related events such as loss of parent's job and other stressors such as hospitalization of the child himself or herself for another illness were significantly associated with AP-FGIDs. According to previous studies, RAP and defecations disorders such as constipation and fecal incontinence are more common among those exposed to stressful life events. Failure at an examination is a significant stress in the competitive school environment in Sri Lanka. Loss of job by a parent would undoubtedly put children under stress because of financial restraints. Alteration of the function of the brain-gut axis under these circumstances may have predisposed children to develop AP-FGIDs. Furthermore, positive family history of functional gastrointestinal disorders and psychiatric disorders are recognized risk factors for developing FGIDs. Information regarding such disorders in first-degree relatives would have been useful to determine the familial tendency. Unfortunately, during validation of the questionnaire and a previous study, we understood that the majority of children are unaware of diseases and symptoms that are present in their family members, especially parents. Therefore, we did not assess family history of FGIDs and psychiatric disorders in the present study.

The present study has several strengths. We have included more than 2000 children from 4 randomly selected provinces (out of 9) of the country to obtain a representative sample. Furthermore, we used standard Rome III criteria to diagnose FGIDs in children. In this questionnaire-based school survey, however, we did not perform a physical examination to exclude organic causes for abdominal pain. In a previous study we have identified organic diseases in 10.9% of children with RAP. The organic diseases observed in the previous study include urinary tract infection, gastroesophageal reflux, urinary calculi, antral gastritis and intestinal amoebiasis. Parasitic infestations such as giardiasis and amoebiasis have been considered to be possible mimickers of FGIDs; however, in that study, prevalence of these diseases was 1.8%. Similarly, several previous studies conducted in Sri Lanka have demonstrated a low prevalence of parasitic infections. Therefore, it is unlikely that parasitic infestations have directly contributed to abdominal symptoms in these children.

In conclusion, AP-FGIDs are common among Sri Lankan children ages 10 to 16 years. IBS is the most common abdominal pain-predominant FGID diagnosed, followed by FAP and FD. AP-FGIDs are significantly higher in girls compared with boys. There is a negative correlation between the age and prevalence of AP-FGIDs. Intestinal-related and extraintestinal symptoms are more frequent in affected children, compared with controls. Exposure to stressful life events is significantly associated with AP-FGIDs.
REFERENCES


