Functional gastrointestinal disorders in children from low socio-economic status and Helicobacter pylori infection

F. Jaime | A. Villagráñ | C. Hernández | M. Ortiz | C. Serrano | P. R. Harris

Abstract

Background: Most studies on functional gastrointestinal disorders (FGIDs) in children are based on data from the northern hemisphere. Scientific reports are arising in South American population, but little is still known about children from low socio-economic status (SES), where Helicobacter pylori infection is endemic. Our objective was to evaluate the prevalence of FGIDs in school children from low SES and its relationship with H. pylori infection.

Methods: Children from 3 public schools of low SES from Santiago de Chile were included. Students completed the Rome III Questionnaire and a survey about other symptoms. Also, the 13C urea breath test determined the presence of H. pylori infection.

Results: Five hundred six children were included, where 48% were male, with a median age of 15.7 years (range 7.1–19.6). Forty-two percent had some FGID, aerophagia and functional constipation being the most frequent. Females (adjusted OR 1.5, 95% CI [1.1, 2.2]), those children with parents within the lowest level of education (adjusted OR 1.6, 95% CI: 1.1–2.4), and family history of gastric cancer (adjusted OR 1.9, 95% CI: 1.2–3.1) were related to FGIDs. The prevalence of H. pylori infection was 55.9% (95% CI [50.7, 60.9]). In multivariable analysis, the presence of abdominal pain (OR 1.55, 95% CI [1.02, 2.36]), but not FGIDs, was related to H. pylori infection.

Conclusions: FGIDs are common in low SES students. A low educational level of the household head, family history of gastric cancer, and being female are related to the development of FGIDs. In this study, no relationship between the presence of H. pylori and FGIDs was found.

1 | INTRODUCTION

Functional gastrointestinal disorders (FGIDs) account for about 2–4% of the consultation in pediatric primary care (Chogle & Saps, 2009; Stein, Chelimsky, Li, & Chelimsky, 2015). According to Rome IV classification, FGIDs are defined as disorders of gut-brain interaction, with gastrointestinal symptoms related to any combination of the following: motility disturbance, visceral hypersensitivity, altered mucosal and immune function, altered gut microbiota, and altered central nervous system processing (Drossman, 2016). Most studies come from developed countries, where FGIDs prevalence is estimated to be up to 27% according to recent publications (Lewis, Palsson, Whitehead, & Van Tilburg, 2016; Van Tilburg et al., 2015). Data about prevalence in developing countries are arising. A study published by Saps et al. found a FGIDs prevalence of 29% in Colombian private and public school students (Saps, Nichols-Vinueza, Rosen, & Velasco-Benitez, 2014). Similar data are reported from Panamá (Lu, Saps, Chanis, & Velasco-Benitez, 2016) and El Salvador (Zabloh, Velasco-Benitez, Merlos, Bonilla, & Saps, 2015).

These disorders have elevated economic costs for patients and their families (Hoekman, Rutten, Vlieger, Benninga, & Dijkstra, 2015) and also affect the quality of life of the children (Varni et al., 2015). The effects could be more devastating in vulnerable populations with low SES.

The pathogenesis of FGIDs is not yet fully understood. Newest deep-sequencing technology has given increased evidence that microbiota plays a role in FGID pathogenesis (Simren et al., 2013). Helicobacter pylori is a known constituent of the gastric microbiome, with pathologic consequences depending on the strain, host genotype, and environmental factors (Gienesberger et al., 2016). Nowadays, H.
pylori is also considered a modulator of immune response (Arnold et al., 2011; Serrano et al., 2011), and further, it induces changes in the microbiome beyond the stomach (Kienesberger et al., 2016).

Data on the relationship between H. pylori infection and chronic abdominal pain are controversial (Dore et al., 2012; Pensabene et al., 2015; Saps et al., 2008; Senbanjo, Oshikoya, & Njokanna, 2014; Spee, Madderom, Pijpers, Van Leeuwen, & Berger, 2010). Recent studies have shown a relationship between H. pylori infection and recurrent abdominal pain in children (Senbanjo et al., 2014), particularly in those with dyspeptic symptoms (Sykora et al., 2016).

Chile is a developing country where 73% of adult population is H. pylori sero-positive (Ferreccio et al., 2007). This infection, acquired in childhood, closely correlates with poor socio-economic conditions (Calvet, Ramirez Lazaro, Lehours, & Megraud, 2013).

The main aim of this study was to determine the frequency of FGIDs in school children from low SES and, secondarily, to evaluate the relationship between these disorders and H. pylori infection and other demographic factors in a country with a high rate of H. pylori infection.

2 | METHODS

2.1 | Study design

Between October and December 2013, students from three public schools in Santiago de Chile were included in this cross-sectional study. These schools had a high school vulnerability index, a socio-economic and cultural indicator built by the National Board of Student Aid and Scholarships (JUNAEB, by its Spanish abbreviation) from a multidimensional analysis that assigns funding to programs for disadvantaged populations. At a school meeting, parents and guardians were invited to participate in the study.

2.2 | Eligibility criteria

Inclusion criteria considered children born in Chile, because studies have shown that immigrant population have a prevalence of infection by H. pylori similar to their population of origin (Ostberg, Alfen, & Hjem, 2006). All participants and/or their parents should know to read/write in order to complete the questionnaires. Exclusion criteria considered use of antibiotics, proton pump inhibitors, or histamine receptor inhibitors in the last month because they can alter the performance of 13C urea breath test (UBT).

2.3 | Rome III questionnaire and biodemographic and other symptoms survey

To evaluate the presence of FGIDs according to Rome III criteria, participants and/or their parents completed the Rome III Diagnostic Questionnaire for the Paediatric Functional GI Disorders at home in its Spanish version provided by The Rome Foundation. To further increase the understanding of the questionnaire, some words were changed according to local idiosyncrasies.

In addition, participants and/or their parents were asked to complete a survey that included the following items: age, gender, abdominal pain within the last 3 months (yes/no), number of people living in the same house, bed sharing (yes/no), room sharing (yes/no), educational level of the head of household, and family history of gastric cancer (yes/no). Whenever these questionnaires were doubtfully fulfilled, a member of our research staff reached the student to further clarify the answers.

2.4 | H. pylori infection

In those participants who also accepted, the presence of H. pylori infection through 13C UBT was determined. In fasting conditions, children had to exhale into a first bag, which was used as baseline sample. They received 75 g of 13C urea (Heli-Breathe-13C [urea] breath test kit, Beijing Richen-Force Science & Technology Co., Ltd, Beijing, China), which were mixed with 200 cc of juice and administered according to the instructions of the manufacturer. Thirty minutes after drinking the juice, children were asked to exhale into a second bag. Samples taken at each school were transported to our laboratory for analysis with 13C Infrared Spectrometer Analyzer (R-Force 200, Beijing Richen-Force Science & Technology Co., Ltd, Beijing, China). Those with a delta over baseline ≥4% were considered “positive tests.”

2.5 | Statistical analysis

A minimum sample size of 317 students was estimated, assuming a FGIDs frequency of 29% as previously published (Saps et al., 2014) and 5% error. The presence of FGIDs and its subtypes according to the Rome III criteria was assessed as the dependent variable. Independent variables were gender, age (in years), number of households, educational level of the household head (incomplete primary school or less, complete primary school, incomplete secondary school, complete secondary school, incomplete technical education or incomplete university education, or more), history of gastric cancer in first or second-degree relatives (yes/no), and H. pylori (positive/negative test). A database was created and analysed using IBM® SPSS® 20.0.
Frequencies for different variables, medians, and interquartile range were calculated. To assess statistical differences between numerical variables, Mann-Whitney’s U-test was used. To assess statistical differences between categorical variables, chi-square test was used. To assess the relationship between different variables, the presence of FGIDs and the relationship between different variables and infection by H. pylori, multivariate logistic analysis were performed. Statistical significance was considered when P value < .05.

2.6 | Ethical considerations

Children and their parents signed informed consent and, in the appropriate cases, informed assent. This project had the approval of the Institutional Review Board (n°13-342) from the School of Medicine, Pontificia Universidad Católica de Chile, and complies with the Declaration of Helsinki.

3 | RESULTS

3.1 | Participant characteristics

Five hundred six students and their parents agreed to participate. Forty-eight percent of the students were male. Variable Age did not have a normal distribution, with a median of 15.7 years (range from 7.1 to 19.6 years). Table 1 shows the distribution of sociodemographic and symptom variables. Abdominal pain and nausea were significantly more reported by girls than boys.

3.2 | Functional gastrointestinal disorders

Two hundred three students (42.1%) met criteria for FGIDs. Eighty-four participants (39.4%) of those who met diagnostic criteria for any FGID met criteria for more than one. From 260 participants who reported abdominal pain at least once a month in the previous 3 months, 63.1% met criteria for a FGID. Females had higher frequency of FGIDs (OR 1.2, 95% CI [1.0, 1.4]). This higher risk further increased when evaluating for pain-related FGIDs (OR 2.0, 95% CI [1.3, 3.0]).

Of those who met FGID criteria, 31.4% reported missing of school days or stopping activities “sometimes” or more often versus 5.8% of those who did not meet criteria (P < .001, OR 7.5, 95% CI [4.2, 13.2]).

Nausea was reported in 66.2% of students with FGIDs, versus 16.4% in those without FGIDs (P < .001).

In univariate analysis, differences of demographic and clinical characteristics among children with or without FGIDs were found. Those who fulfilled criteria for FGID were more likely to be female, share their bed for sleeping, have a family history of gastric cancer, and have a lower educational level of the head of household. The distribution of each FGID according to Rome III classification is shown in Table 3.

### Table 1  Sociodemographic characteristics and symptoms of participants

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Male N = 243</th>
<th>Female N = 263</th>
<th>Total N = 506</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (IQR)</td>
<td>15.7 (14.1-16.9)</td>
<td>15.7 (14.6-17.1)</td>
<td>15.7 (14.6-17)</td>
<td>.42</td>
</tr>
<tr>
<td>Number of households, median (IQR)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>.53</td>
</tr>
<tr>
<td>Room sharing, (yes) %</td>
<td>44.4</td>
<td>50.9</td>
<td>47.8</td>
<td>.07</td>
</tr>
<tr>
<td>Gastric cancer in family history, (yes) %</td>
<td>18.9</td>
<td>17.5</td>
<td>18.2</td>
<td>.33</td>
</tr>
<tr>
<td>Symptoms in last 3 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal pain, %*</td>
<td>42.4</td>
<td>59.7</td>
<td>51.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Upper abdominal pain, %</td>
<td>25.1</td>
<td>37.3</td>
<td>31.4</td>
<td>.002</td>
</tr>
<tr>
<td>Lower abdominal pain, %</td>
<td>36.2</td>
<td>49.8</td>
<td>43.3</td>
<td>.002</td>
</tr>
<tr>
<td>Nausea, %</td>
<td>27.2</td>
<td>46.8</td>
<td>37.6</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Note. IQR = interquartile range.

*Abdominal pain at least once a month.

### Table 2  Demographic characteristics and functional gastrointestinal disorders

<table>
<thead>
<tr>
<th>FGIDs, yes N = 213</th>
<th>FGIDs, no N = 293</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, %</td>
<td>58.2</td>
<td>47.4</td>
</tr>
<tr>
<td>Number of households, median (IQR)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
</tr>
<tr>
<td>Number of households &gt; 18 y/o, median (IQR)</td>
<td>3 (2-4)</td>
<td>3 (2-4)</td>
</tr>
<tr>
<td>Number of households ≤ 18 y/o, median (IQR)</td>
<td>2 (1-3)</td>
<td>2 (1-3)</td>
</tr>
<tr>
<td>Room sharing (yes), %</td>
<td>46.9</td>
<td>48.5</td>
</tr>
<tr>
<td>Bed sharing (yes), %</td>
<td>14.6</td>
<td>8.9</td>
</tr>
<tr>
<td>Family history of gastric cancer (yes), %</td>
<td>23.4</td>
<td>14.3</td>
</tr>
<tr>
<td>Educational level of household head (primary or less), %</td>
<td>39.9</td>
<td>29.4</td>
</tr>
</tbody>
</table>

Note. FGIDs = functional gastrointestinal disorders; IQR = interquartile range.
TABLE 3  Frequency of FGIDs

<table>
<thead>
<tr>
<th>FGID</th>
<th>N</th>
<th>%  (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a. Adolescent rumination</td>
<td>1</td>
<td>0.2 (0.0, 1.0)</td>
</tr>
<tr>
<td>H1b. Cyclic vomiting syndrome</td>
<td>10</td>
<td>2 (1.1, 3.6)</td>
</tr>
<tr>
<td>H1c. Aerophagia</td>
<td>68</td>
<td>13.4 (10.7, 16.7)</td>
</tr>
<tr>
<td>H2a. Functional dyspepsia</td>
<td>5</td>
<td>1 (0.4, 2.3)</td>
</tr>
<tr>
<td>H2b. IBS</td>
<td>66</td>
<td>13 (10.3, 16.3)</td>
</tr>
<tr>
<td>H2c. Abdominal migraine</td>
<td>62</td>
<td>12.3 (9.7, 15.4)</td>
</tr>
<tr>
<td>H2d. FAP</td>
<td>19</td>
<td>3.8 (2.3, 5.9)</td>
</tr>
<tr>
<td>H2d. FAP syndrome</td>
<td>13</td>
<td>2.6 (1.5, 4.3)</td>
</tr>
<tr>
<td>H3a. Functional constipation</td>
<td>71</td>
<td>14 (11.3, 17.3)</td>
</tr>
<tr>
<td>H3b. Non_retentive fecal incontinence</td>
<td>3</td>
<td>0.6 (0.2, 1.7)</td>
</tr>
<tr>
<td>Any FGID</td>
<td>213</td>
<td>42.1 (37.8, 46.5)</td>
</tr>
</tbody>
</table>

Note. IBS = irritable bowel syndrome; FAP = functional abdominal pain; FGID = functional gastrointestinal disorder.

In multivariate analysis, only the following variables were positively associated with the presence of FGIDs: family history of gastric cancer (adjusted OR 1.9, 95% CI [1.2, 3.1]), educational level of the household head (primary or less) (adjusted OR 1.6, 95% CI [1.1, 2.4]), and female gender (adjusted OR 1.5, 95% CI [1.1, 2.2]).

3.3 H. pylori infection

Three hundred fifty-eight (70.8%) participants accepted to perform 13C UBT. Of these, 55.7% had a positive result (95% CI [50.7, 60.7]). Their sociodemographic characteristics are shown in Table 4. FGIDs distribution is shown in Table 5. In univariate and multivariate analysis, only the history of abdominal pain in the previous 3 months (yes or no) was associated with increased likelihood of H. pylori infection (OR 1.55, 95% CI [1.02, 2.36]). The presence of FGIDs as a group and/or its subgroups, including those pain-related, did not increase the likelihood of infection (data not shown). Of note, the only three students with dyspepsia who underwent UBT were positive.

4 DISCUSSION

Our study found a frequency of FGIDs of 42% in children from vulnerable schools in a developing country. This prevalence is higher than previous reports from students from public and private schools in Latin America: 29% in Panamá (Lu et al., 2016) and Colombia (Saps et al., 2014), 23% in Ecuador (Jativa, Velasco-Benitez, Koppen, Jativa-Cabezas, & Saps, 2016), and 20% in El Salvador (Zablah et al., 2015). A recent report from the United States detected a prevalence of 23% (Lewis et al., 2016). We used a very similar methodology compared to Latin American studies; therefore, this difference may not be due to methodological reasons. Further, these studies found lower prevalence of FGIDs in public versus private schools. However, other studies have found the opposite relationship between social factors and FGIDs. Studies in Sweden and The Netherlands found higher frequency of recurrent abdominal pain in adolescents with “economic stress” (OR 1.46; Östberg et al., 2006) or lower income quintiles (Groholt, Stigum, Nordhagen, & Kohler, 2003). A systematic review further supported these studies (Chikara, Rawat, & Talley, 2005), whereas other did not (King et al., 2011). Also, a follow-up study that was done by those who lived in a lower socioeconomic class experienced a higher frequency of adult IBS according to Manning and Rome II Criteria (Howell, Talley, Quine, & Poulton, 2004). Given these controversial data, the frequency of FGIDs according to socio-economic level should be explored in future studies.

TABLE 4  Demographic characteristics, symptoms, and frequency of FGIDs according to H. pylori status

<table>
<thead>
<tr>
<th>FGID</th>
<th>H. pylori (+)</th>
<th>H. pylori (-)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 200</td>
<td>N = 158</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in years, median (IQR)</td>
<td>15.4 (13.4-16.7)</td>
<td>15.7 (14.6-16.8)</td>
<td>.39</td>
</tr>
<tr>
<td>Female, %</td>
<td>56.5</td>
<td>48.7</td>
<td>.14</td>
</tr>
<tr>
<td>Number of households, median (IQR)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>.72</td>
</tr>
<tr>
<td>Gastric cancer in family history, (yes) %</td>
<td>16</td>
<td>17.7</td>
<td>.33</td>
</tr>
<tr>
<td>Symptoms in last 3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal pain, (yes) %</td>
<td>56.5</td>
<td>45.6</td>
<td>.04</td>
</tr>
<tr>
<td>Nausea, (yes) %</td>
<td>39.5</td>
<td>38.6</td>
<td>.86</td>
</tr>
</tbody>
</table>

Note. FGID = functional gastrointestinal disorder; H. pylori = Helicobacter pylori; IQR = interquartile range.
Other reasons may explain the high FGIDs frequency found in our study, such as psychological factors. Mood and anxiety disorders are known to be risk factors for development and exacerbation of FGIDs symptoms (Van Oudenhove et al., 2016). Depression and anxiety disorders are frequent in Chilean adolescent population, with reported prevalence for depression between 13% and 44% (Araya et al., 2013) and 42% for anxiety (Cova, Meléjilín, Valdés, Bravo, & Valenzuela, 2007). Our prevalence data may then reflect a highly distress young population in our country.

FGIDs are related to poorer quality of life (Varni et al., 2015). In our study, those with FGIDs had more than 7 times more risk of school absenteeism or interference with daily activities versus those without FGIDs. This could have particularly important consequences in children from low SES, as chronic school absenteeism is related to school drop-off and lower academic scores (Chang & Romero, 2008).

Our analysis found a higher frequency of FGIDs in females than in males, particularly in pain-related FGIDs, which is also described in literature (King et al., 2011; Saps et al., 2014), although not in all series (Jativa et al., 2016; Zabrah et al., 2015). This higher incidence of pain-related symptoms in young females has also been reported in other types of chronic pain (King et al., 2011).

Newer childhood Rome IV classification includes functional nausea and functional vomiting (Hyams et al., 2016). Although not intended to evaluate this disorder, 37% of students reported nausea as a complaint, with higher frequency in females and those with FGIDs. A study in children with FGIDs found that 53% of them have nausea at least 2 times a week (Kovacic, Williams, Li, Chelinsky, & Miranda, 2013), and recently, 16% of nausea has been described in Latin American children in a school population-based study (Saps et al., 2016).

The current study highlights the significant association of FGIDs in offspring of parents with lower educational levels. A systematic review found a similar relationship of lower educational levels and other types of chronic pain in children, such as headaches (King et al., 2011), but this needs to be further studied.

We found higher frequency of FGIDs in school children with family history of gastric cancer in first- or second-degree relatives. Caregivers of cancer patients are described to have higher incidence of depression and anxiety disorders (Park et al., 2013). Also, parental psychological status is related to FGIDs in the offspring (Van Oudenhove et al., 2016). Therefore, it is plausible that the stress of being involved in caring for gastric cancer patients may raise the frequency of FGIDs in children.

The current study found a frequency of 55.9% of H. pylori infection. A previous report from our group in Chilean students from middle SES with comparable mean age and gender distribution found a prevalence of 18% (Jaime, Villagrán, Serrano, Cerdá, & Harris, 2013). This difference could be explained by the lower SES of this studied population. The Chilean 2003 National Health Survey found a prevalence of H. pylori infection determined by serum IgG determination of 73% (Ferreccio et al., 2007). The current study found a higher prevalence of H. pylori infection in populations of low SES based on 13C-UBT, a more specific diagnostic test for infection than serum IgG. This frequency is important in our country, given that H. pylori is a known risk factor for gastric cancer (Yang et al., 2016), and Chile is a country with one of the world's highest prevalence and mortality due to gastric cancer (American Cancer Society, 2015).

There was no relationship between H. pylori infection and FGIDs; however, this bacterium was associated with the presence of abdominal pain when abdominal pain was asked in a different survey than Rome III Questionnaire (asking for presence or absence of abdominal pain). Although the role of H. pylori in developing antral gastritis and gastroesophageal ulcers in children and adult patients is well established, the association between infection and abdominal symptoms in the absence of endoscopic findings is controversial (Campo et al., 2004; Macarthur, 1999; Macarthur, Saunders, & Feldman, 1995; Spee et al., 2010). A meta-analysis published in 2010 found no significant association with recurrent abdominal pain, but studies had significant heterogeneity (Spee et al., 2010). Consistent with our findings, this meta-analysis noted a significant association between H. pylori infection and epigastric pain or pain in upper abdomen. Newer data support the relationship of H. pylori and functional dyspepsia (Sykora et al., 2016). In our study, 100% of students with functional dyspepsia were H. pylori positive; however, the number of students with this condition was too low and does not allow drawing any conclusion.

This study has some limitations. As an epidemiologic study, we did not assessed organicity in every student; however, FGIDs may coexist with organicity (Torres et al., 2016). Also, the auto-administered questionnaires could hinder understanding of the questions. However, to increase understanding, we adjusted some specific words to fit local idiosyncrasy and reached the students when there were doubt about their answers.

The strengths of this study include (a) availability of clinical information on a large number of children; (b) inclusion of low SES students, a less studied population; (c) diagnosis of FGIDs made following Rome III guidelines by a questionnaire; and (d) state-of-the-art non-invasive technique diagnosed H. pylori infection in subjects.

In conclusion, FGIDs are common in students from low SES and are more often found in females, in offspring of parents with lower educational level, and in those with family history of gastric cancer. In this study, a high frequency of H. pylori infection associated with the presence of abdominal pain but not with FGIDs. This is important, considering the inequality in access to health care, in this vulnerable population.

FUNDING
This study was supported by Comisión Nacional de Investigación Científica y Tecnológica (CONICYT), Grant Number 1130387 and Pontificia Universidad Católica de Chile, Grant Number Proyecto Puente 15/2013.

CONFLICT OF INTERESTS
The authors report no conflict of interest.

ACKNOWLEDGEMENTS
The authors thank Ivonne Guisellini, Natalie González, Roberto Correa, and Carlos Ireland for their support at each school; Dr. Paula Troncoso who helped in collecting samples; Dr. Ernesto Guiñalde for reviewing this article; and Jonathan Nurko for his help with English style.
REFERENCES

Atlanta: American Cancer Society.

Araya, R., Montero-Marin, J., Barceloht, S., Fritsch, R., Gaete, J., &
Montgomery, A. (2013). Detecting depression among adolescents in
Santiago, Chile: Sex differences. BMC Psychiatry, 23, 122.

Arnold, I. C., Delzard, N., Reuter, S., Martin, H., Becker, B., Taube, C., &
Mueller, A. (2011). Helicobacter pylori infection prevents allergic asthma in
mouse models through the induction of regulatory T cells. The Journal of
Clinical Investigation, 121, 3088-3093.

sis and epidemiology of helicobacter pylori infection. Helicobacter, 18(Suppl 1), 5-11.

Campos, J. V., Bridge, J., Ehmann, M., Altman, S., Lucas, A., Birmaher, B.,...
Brent, D. A. (2004). Recurrent abdominal pain, anxiety, and depression in

chronic absence in the early grades. http://www.nccp.org/publica-
tions/pub/637.htm (accessed August, 8th, 2013)

Chikara, D. K., Rawat, D. J., & Tailey, N. J. (2005). The epidemiology of
childhood recurrent abdominal pain in western countries: A systematic
review. The American Journal of Gastroenterology, 100, 1868-1875.

Pediatric Annals, 38, 398-401.

Sintomatología depresiva y ansiosa en estudiantes de enseñanza media.
Revista Chilena de Pediatría, 78, 151-159.

Dore, M. P., Fanciulli, G., Tomasi, P. A., Realdi, G., Deitilo, G., Graham, D. Y.,
& Malati, H. M. (2012). Gastric symptomsof and helicobacter pylori
infection in school-age children residing in Porto Torres, Sardinia,
Italy. Helicobacter, 17, 369-373.

pathophysiology, clinical features and Rome IV. Gastroenterology, 150,
1262-1279.

Ferrecci, C., Rolán, A., Harris, P. R., Serrano, C., Gederlin, A., Margozaži, P.,...
Agüera, X. (2007). Gastric cancer is related to early helicobacter pylori
infection in a high-prevalence country. Cancer Epidemiology, Biomarkers &
Prevention, 16, 662-667.

pain in children, socio-economic factors and accumulation in families.
European Journal of Epidemiology, 18, 965-975.

Hoekman, D. R., Rutten, J. M., Vlieger, A. M., Benninga, M. A., & Dilggra,
syndrome, functional abdominal pain, and functional abdominal pain

syndrome has origins in the childhood socio-economic environment. The

Hyams, J. S., Di Lorenzo, C., Saps, M., Shulman, R. J., Staiano, A., &
Gastroenterology, 150, 1454-1468.

Frequency of helicobacter pylori infection in 144 school age Chilean

Javila, E., Viecaso-Benitez, C., Koppren, I. J., Javila-Caberas, Z., & Saps,
schoolchildren in Ecuador. Journal of Pediatric Gastroenterology and

Kenesberger, S., Cox, L. M., Livanos, A., Zhang, X. S., Chung, J., Perez-
Perme, G. I., ... Blaser, M. J. (2016). Gastric helicobacter pylori infection
affects local and distant microbial populations and host responses. Cell
Reports, 14, 1395-1407.

King, S., Chambers, C. T., Huguet, A., Macnevin, R. C., McGrath, P. J., Parker,
children and adolescents revisited: A systematic review. Pain, 152,
2729-2738.

prevalence of nausea in children with pain-associated functional
gastrointestinal disorders: Are Rome criteria applicable? Journal of
Pediatric Gastroenterology and Nutrition, 57, 311-315.

Prevalence of functional gastrointestinal disorders in children and

prevalence of functional gastrointestinal disorders in children in

Canadian Journal of Gastroenterology, 13, 607-610.

gastroesophageal disease, and recurrent abdominal pain in children.
JAMA, 273, 729-734.


among family caregivers of cancer patients: A nationwide survey of
patient-family caregiver dyads in Korea. Support Care Cancer, 21,
2799-2807.

Pensabene, L., Taricco, V., Concolino, D., Ciliberto, D., Campanozzi, A.,
Gentile, T., ... Post Infectious Functional Gastrointestinal Disorders
Study Group of Italian Society for Pediatric Gastroenterology, H., &
Nutrition, Post Infectious Functional Gastrointestinal Disorders
Study Group of Italian Society for Pediatric Gastroenterology, H., &

Saps, M., Niño-de-Vivancos, D. X., Rosen, J. M., & Viecaso-Benitez, C. A.


Saps, M., Viecaso-Benitez, C., Kovács, K., Chelimsky, G., Kovács, K.,
Javila Marino, E., ... Zablah, R. (2016). High prevalence of nausea among
e101.

pylori associated with breastfeeding, nutritional status and recurrent
abdominal pain in healthy Nigerian children. Journal of Infection in
developing Countries, 8, 448-453.

Serrano, C. A., Taesink, E., Peña, A., Rolán, A., Duarte, I., Torres, J.,...
Harris, P. R. (2011). Inverse correlation between allergy markers and
Helicobacter pylori infection in children is associated with elevated
levels of TGF-β. European Journal of Gastroenterology & Hepatology,
23, 656-663.

Sinmen, M., Barbara, G., Flint, H. J., Spiegel, B. M., Spiller, R. C., Vanner, S.,...
in functional bowel disorders: A Rome foundation report. Gut, 62,
159-176.

(2010). Association between helicobacter pylori and gastrointestinal

testinal disorders in a primary care pediatric clinic. Glob Pediatr Health, 2,
1-9.

Szykora, J., Huns, M., Sia, K., Pomahacova, R., Jhiliaka, P., Liska, J.,...
is associated with Helicobacter pylori and not with caiprotecin. *Journal of Pediatric Gastroenterology and Nutrition*, 63, 417–422.


How to cite this article: Jaime F, Villagráín A, Hernández C, Ortiz M, Serrano C, Harris PR. Functional gastrointestinal disorders in children from low socio-economic status and Helicobacter pylori infection. *Child Care Health Dev.* 2018;44:319–325. [https://doi.org/10.1111/cch.12486](https://doi.org/10.1111/cch.12486)