A nationwide study on the prevalence of functional gastrointestinal disorders in school-children

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Abstract

Introduction: Functional gastrointestinal disorders (FGIDs) are highly prevalent worldwide and are thought to result from the interplay of multiple factors that can vary from region to region. Nationwide studies can help understand the regional epidemiology and the pathogenesis of FGIDs. The objectives of this study were to determine the prevalence of FGIDs in school-children of Colombia and assess associated factors. **Methods:** A cross-sectional study was carried out at 12 private and public schools in 10 cities distributed through the four main geographic regions of Colombia. School-children completed a validated questionnaire to assess functional gastrointestinal disorders according to Rome III criteria. Demographic information and past medical and family history were obtained from the parents. **Results:** 4394/5062 (86.8%) children participated in the study, with ages ranging from 8-18 years (mean = 11.9, SD = 2.3). 23.7% of children had at least one FGID. Disorders of defecation were the most common category FGID (11.7%) followed by abdominal pain-related functional gastrointestinal disorders (10.4%). Children have increased odds of FGIDs if they have separated parents (OR 1.22, $p = 0.007$), attend private school (OR 1.54, $p < 0.001$), or have nausea (OR 3.16, $p < 0.001$). **Conclusions:** This large epidemiological study of pediatric FGIDs is the first to evaluate a broad cross-section of children throughout a nation in the Americas. High prevalence of FGIDs and identified associations with their likelihood are relevant when providing medical care and when planning public health efforts.

Key words: Functional gastrointestinal disorder. Abdominal pain. Constipation. Pediatric. Latin America.

Prevalencia de desórdenes gastrointestinales funcionales en niños. Un estudio a nivel nacional

Resumen

Introducción: Los desórdenes gastrointestinales funcionales (DGF) son altamente prevalentes a nivel mundial. Se postula que estos desórdenes resultan del interjuego de múltiples factores que pueden variar regionalmente. Estudios a nivel nacional pueden ayudar a comprender la epidemiología regional y la patogénesis de los DGFs. Los objetivos del estudio fueron determinar la prevalencia de DGFs en escolares en Colombia y establecer los factores asociados. **Métodos.** Estudio de corte transversal realizado en 12 escuelas privadas y públicas en 10 ciudades de las 4 regiones principales de Colombia.

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Niños de edad escolar completaron un cuestionario validado para diagnosticar DGFs de acuerdo con los criterios de Roma III. Información demográfica e historia personal y familiar fue obtenida de los padres. **Resultados:** 4394/5062 (86.8%) niños participaron en el estudio, rango de edad 8-18 años (promedio = 11.9, Desviación Estándar (DE) = 2.3). 23.7% de los niños tuvieron al menos un DGF. Los desórdenes de la defecación fueron los más frecuentes (11.7%), seguidos por desórdenes funcionales de dolor (10.4%). Niños cuyos padres estaban separados (Razón de momios (RM) 1.22, $p=0.007$), cursaban en escuela privada (RM 1.54, $p<0.001$) o reportaban náuseas (RM 3.16, $p<0.001$) tuvieron mayor riesgo de DGFs. **Conclusiones:** Este estudio de DGFs es el primero en evaluar un grupo numeroso de niños en diferentes regiones de un país americano. La alta prevalencia de DGFs y la identificación de asociaciones que aumentan el riesgo de desarrollar estos desórdenes son hallazgos relevantes para proveer cuidados médicos y planear estrategias de salud pública.

Palabras clave: Desórdenes gastrointestinales funcionales. Dolor abdominal. Estreñimiento. Pediatría. Latinoamérica.

Introduction

Thirty-eight percent of school-children report abdominal pain weekly¹, but only 2-4% of children who report abdominal pain seek medical consultation^{1,2}. Despite this, abdominal pain is the most common cause of consultation with the pediatric gastroenterologist. Out of all children (> 4 years) who consulted pediatric gastroenterology in a tertiary care center in the US, 52% consulted for an abdominal pain associated-functional gastrointestinal disorder (AP-FGID)³. The cost of care of children with AP-FGIDs is substantial. In the Netherlands, the costs of care for a child with AP-FGIDs exceeds €2500⁴. The overall cost of care for AP-FGIDs in the US grew by 300% in a 12-year period⁵, and evaluation of a single child for an AP-FGIDs in the US is estimated > \$6000⁶. The cost of a single consultation for abdominal pain in Uruguay accounted for 3.8% of the per capita health care spending of one year⁷. Although the economic impact of AP-FGIDs has not been studied in most countries, it is likely to be a global economic problem based on the high worldwide prevalence of FGIDs.

The magnitude of the problem calls for preventative measures and plans of care adapted to local needs. However, to establish what the local needs are, it is imperative first to obtain reliable data on the local epidemiology. Due to the low ratio of consultation for abdominal pain, studies performed at the doctor's office are prone to selection bias. Thus, only community studies provide the information needed. Conducting epidemiological studies in private and public schools allow obtaining data from children with different socio-economic statuses. There have been several school studies investigating the prevalence of FGIDs. However, none of them were conducted in private and public schools in multiple cities throughout different regions of one country.

In addition to establishing the regional epidemiology, nationwide studies provide a unique opportunity to achieve a better understanding of the pathogenesis of

FGIDs that is currently elusive. This information is key to establish prevention strategies and effective treatments. The most accepted model to explain FGIDs propose that these disorders result from the interaction of the child's genetic background, early life experiences, intestinal microbiota, as well as psychological and social influences. As these factors vary by region, establishing comparisons among regions could help advance the knowledge of the pathogenesis of FGIDs.

We conducted a large school-based study of FGIDs in multiple cities in Colombia using standardized methods, validated questionnaires adapted to the terms used by children, and the Rome III diagnostic criteria. This study aims to evaluate the prevalence of pediatric FGIDs throughout Colombia and determine if regional differences exist, as well as to identify associated factors.

Methods

The present study is the largest study conducted by the Functional International Digestive Epidemiological Research Survey (FINDERS) group and the broadest national study in the Western Hemisphere on FGIDs in children. This cross-sectional study was carried out at 12 schools in 10 cities of Colombia. Colombia is the second most populated country in South-America, with a population of approximately 50 million⁸ inhabitants. Most of the population is concentrated along the Caribbean coast and the Andean regions. In Colombia, 85% of primary care education students and 60% of the secondary-school level students attend to public schools⁹. To enhance racial, ethnic, and socioeconomic diversity and maximize the external validity of the data, we selected public and private schools as study sites. The study was purposefully designed to enroll a higher proportion of children from public over private schools to resemble the education system of the country. To better represent the population distribution of Colombia, we selected more cities with high population density. The

cities of the study are distributed through the four main regions of Colombia, the Caribbean region (adjacent to the Caribbean Sea), Andean region (by the mountains), the Amazon region (tropical rainforest), and the Pacific region (neighboring the Pacific Ocean). Together, these four regions hold 97.3% of the population in Colombia.

To ensure consistency and to allow comparison within multi-national cross-cultural studies, the study was conducted systematically following the same methods used in previous studies by the international consortium FINDERS^{1,10-12}. The methods used by FINDERS were based on two school-studies performed previously and a prior small study by FINDERS in Colombia. The first study was piloted in a single school in Pittsburgh¹³ followed by a larger study in Chicago to streamline methods². Planning of the current study in Colombia started by translating the English version of the QPGS-III questionnaire into Spanish and local language according to established standards. The self-report child version of the QPGS-III questionnaire (a validated instrument created to assess the full spectrum of FGIDs according to the Rome III criteria) was first translated into Spanish by a bilingual pediatric gastroenterologist and two bilingual medical students, followed by the reverse translation of the QPGS-III by another member of the research team. The resulting English version was then compared with the original English version of the QPGS-III by a native English speaker who was not part of the research team to ascertain fidelity. The finalized Spanish version of the QPGS-III was then presented to two focus groups of children in two different cities in Colombia (Cali and Pasto) to ensure that the terms were adequately understood. Once the Spanish version of the QPGS-III was tested in the focus groups, the methods and the Spanish version of the questionnaire was again tested in the first study by FINDERS in Pasto, Colombia¹. The data obtained from this study using the Spanish version of the QPGS III were analyzed statistically for internal consistency using Cronbach's alpha analysis¹⁴. The study showed high internal consistency. In short, the methods used in the current study were the following: parents of children 8-18 years of age received a package with information on the study at home, a questionnaire on their child's past medical history and a consent form. Children who assented (and whose parents consented) to participate in the study underwent an informative session in class explaining the study and questionnaires. The participants completed the data forms in class with a member of the research team available for questions. The data were entered into an electronic database. In order to ensure the accuracy of data transfer, 10% of the questionnaires were reviewed and compared with the paper forms collected at the school level.

The study was approved by the principal of each of the schools and by the Institutional Review Board and Human Subjects Committee of Universidad del Valle of Cali, Colombia.

Statistical analysis included the calculation of odds ratios, 95% confidence intervals, and *p* values to describe the associations of interest (Stata 10 software, College Station, Texas). Fisher's exact test was used when appropriate. Two-sided *p* values of <0.05 were considered statistically significant.

Results

A total of 5062 families were sent the information package and invited to participate in the study. 4394/5062 (86.8%) dyads (children/caretaker) assented/consented to participate. Participants ranged from 8 to 18 years of age (mean = 11.9, SD = 2.3). There were 2279 boys (51.9%) and 2115 (48.1%) girls; 2702 (61.5%) were children (8 to 12 years) and 1692 (38.5%) adolescents (13 to 18 years). Most children who participated in the study were from public schools 3546 (80.7%), and 848 (19.3%) were from private schools.

FGID prevalence

Regarding FGID prevalence, 23.7% of children in the total sample had at least one FGID (Table 1). The range of FGID per region varied between 19.8% (Pacific region) to 26.5% (Amazonia region). There was a significant difference in FGID prevalence between regions ($p = 0.001$). Additional analysis of regional FGID prevalence identified differences between Andean and Pacific regions ($p < 0.001$) and Amazonia and Pacific regions ($p = 0.007$). Disorders of defecation (functional constipation and non-retentive fecal incontinence) were the most common category of FGIDs (11.7%), followed by AP-FGIDs (10.4%) and vomiting/aerophagia (1.6%). Functional constipation accounted for nearly all disorders of defecation ($n=509/512$, 99.4%), and IBS was the most common AP-FGIDs ($n = 222/457$, 48.6%).

Demographics and family

FGIDs were significantly less common in adolescents than children (21.5% vs. 25.1%, OR 0.82) (Table 2). Males had significantly fewer FGIDs than females (21.9% vs. 25.6%, OR 0.81). Concerning the marital status of the parents, 2189 children had married parents, and there was a higher prevalence of FGIDs among children whose parents were separated/divorced (25.3%

Table 1. Prevalence of functional gastrointestinal disorders by region

	Andean	Atlantic	Pacific	Amazonia	Colombia
Total	1544	1373	1085	392	4394
No FGIDs	1141 (73.9%)	1055 (76.8%)	870 (80.2%)	288 (73.5%)	3354 (76.3%)
FGIDs	403 (26.1%)	318 (23.2%)	215 (19.8%)	104 (26.5%)	1040 (23.7%)
Vomiting and aerophagia					71 (1.6%)
Aerophagia	7 (0.5%)	19 (1.4%)	11 (1.0%)	0	37 (0.8%)
Cyclic vomiting syndrome	5 (0.3%)	5 (0.4%)	5 (0.5%)	2 (0.5%)	17 (0.4%)
Adolescent Rumination Syndrome	4 (0.3%)	9 (0.7%)	3 (0.3%)	1 (0.3%)	17 (0.4%)
Abdominal pain predominant-FGIDs					457 (10.4%)
Functional dyspepsia	13 (0.8%)	11 (0.8%)	16 (1.5%)	6 (1.5%)	46 (1%)
IBS	87 (5.6%)	68 (5.0%)	49 (4.5%)	18 (4.6%)	222 (5.1%)
Abdominal migraine	36 (2.3%)	12 (0.9%)	24 (2.1%)	4 (1.0%)	76 (1.7%)
Functional abdominal pain	31 (2.0%)	18 (1.3%)	19 (1.8%)	8 (2.0%)	76 (1.7%)
Functional abdominal pain syndrome	22 (1.4%)	5 (0.4%)	9 (0.8%)	1 (0.3%)	37 (0.8%)
Constipation and incontinence					512 (11.7%)
Functional constipation	198 (12.8%)	171 (12.5%)	76 (7.0%)	64 (16.3%)	509 (11.6%)
Non-retentive fecal incontinence	0	0	3 (0.3%)	0	3 (0.07%)

FGID, Functional gastrointestinal disorder; IBS, irritable bowel syndrome

Table 2. Relationship between the presence of FGIDs and sociodemographic and familial variables in children in Colombia

Variable	Total (n)	FGID (n)	OR	95% CI	p-value
Sociodemographics					
Age (years)					
Children (8-12)	2702	677	1	0.71-0.94	<0.01
Adolescent (13-18)	1692	363	0.82		
Gender					
Female	2115	542	1		
Male	2279	498	0.81	0.71-0.93	<0.01
School type					
Public	3546	782	1		
Private	848	258	1.54	1.30-1.83	<0.01
Familial					
Divorced or separated parents					
No	2189	475	1		
Yes	1849	468	1.22	1.05-1.41	<0.01
History of FGIDs					
Yes	261	71	1		
No	3939	916	1.23	0.91-1.64	0.14
Siblings					
With siblings	3692	864	1	0.86-1.35	0.44
Without siblings	501	125	1.08		

FGID, Functional gastrointestinal disorder; OR, Odds ratio; CI, Confidence interval

vs. 21.7%, OR 1.22). Children from private schools had significantly more FGIDs than children from public schools (30.4% vs. 22.1%, OR 1.54). There was a greater frequency of FGIDs among children with parents

who had FGIDs, but the difference was not significant (37.4% vs. 23.3%, OR 1.23). There was no difference in prevalence of FGIDs between children with and without siblings (23.4% vs. 25.0%, OR 1.08).

Association with nausea

Nausea was reported in 10.5% of all children and was significantly more common among children with FGIDs (OR 3.63; 95% CI 2.96-4.44; $p < 0.001$). There was an association of nausea with most FGIDs: IBS (OR 5.10; 95% CI 3.74-6.92; $p < 0.001$), functional abdominal pain (OR 4.71; 95% CI 2.18-9.71; $p < 0.001$), abdominal migraine (OR 4.62; 95% CI 2.73-7.66; $p < 0.001$), functional dyspepsia (OR 3.80; 95% CI 1.86-7.40; $p < 0.001$), and functional constipation (OR 1.42; 95% CI 1.06-1.87; $p = 0.011$). There was no significant association between nausea and aerophagia, rumination, cyclic vomiting syndrome, or non-retentive fecal incontinence.

Discussion

The present study is the largest epidemiological study conducted in the Western Hemisphere aimed at describing FGIDs in children using the Rome III criteria. The study included 4394 children from 12 public and private schools in 10 geographically dispersed cities in Colombia, providing a broad-based survey throughout a Latin American nation. The nationwide distribution of our sample and the high acceptance rate to participate in the study (86.8%) indicates the external validity of our data. We found that almost one in four children (23.7%) had an FGID according to the Rome III criteria. The prevalence of FGIDs found in this study was similar to that found in Quito (22.8%)¹², the capital of Ecuador, which borders Colombia to the South. Similar to the results of this study (11.6%), functional constipation was the most common FGID in Ecuador (11.8%).

We found that 10.4% of children in Colombia had AP-FGIDs, which again is within close range to the prevalence of AP-FGIDs found in Ecuador (9.4%) using the same methods¹². A review of AP-FGIDs in children found that worldwide pooled prevalence of AP-FGIDs was higher than in our sample 13.5% (95% CI 11.8-15.3)¹⁵. The study identified IBS as the most common AP-FGID, but at higher rates (8.8%, 95% CI 6.2-11.9) than in our study (5.1%). The study found a high range of AP-FGID prevalence across countries ranging from 1.6% to 41.2%. Prevalence of adult IBS is estimated to be 21-26% in Peru¹⁶ and 19.9% in Colombia, which are higher than the present results in children. The reasons for the differences in the prevalence of AP-FGIDs between children and adults and among geographic regions remains unknown and should be studied with large international comparative studies using standardized methodology and subjects of different age groups.

FGIDs were more common in children from private than public schools and in children whose parents were separated. Another Latin-American study also found that children from divorced/separated families had a higher prevalence of FGIDs¹¹ than children from intact families. Although the design of this study does not allow determination of causality, the results are in line with the biopsychosocial model that proposes psychological and social factors play a role in the pathogenesis of FGIDs. According to the biopsychosocial model, AP-FGID symptoms result from the interaction of gastrointestinal and central nervous system factors¹⁷. Stress has pathophysiological effects in the gastrointestinal tract. Higher stress levels can trigger or exacerbate abdominal pain through visceral hypersensitivity and changes in motility. Children with depressive or anxious symptoms are more likely to suffer from AP-FGIDs¹⁸ and studies in school-children found an association between anxiety and depression with abdominal pain¹⁹. Divorce is a major stressor²⁰, and parental separation and divorce are associated with higher rates of depression²¹. Studies comparing early adolescents from divorced and intact families found that adolescents from divorced families had a higher rate of anxiety and more depressed mood²². A higher prevalence of FGIDs in children from private schools was also found in other studies conducted in Latin-American countries such as El Salvador¹¹ and Ecuador¹². A study that interviewed more than 500 adolescents in Colombia found higher levels of anxiety among children of public schools²³. However, the study was performed in a single town near Bogota, and it is also known that the interrelation between the psychological factors involved in the pathogenesis of FGIDs is complex²⁴. Moreover, other non-psychological factors could explain these findings. Future studies by FINDERS will specifically investigate these issues.

Despite previous studies in the United States showing that children of parents with IBS reported more GI symptoms^{25,26}, we did not find an association between FGIDs and family history. A family history of FGIDs also did not associate with a higher prevalence of FGIDs in Salvadoran children¹¹. The reason for this difference is unclear. Cultural differences in the way an FGID is conceptualized and differences in parenting and coping styles between the US and Latin-American societies may explain these differences.

We did not find gender predominance in FGIDs. These results are similar to those of pediatric studies in Mexico²⁷, Ecuador¹², Panama¹⁰, and El Salvador¹¹. A meta-analysis by Lovell and Ford¹⁶ found a female predominance in adults with IBS. However, this

difference was not found when South-American studies were analyzed as a whole.

Limitations of our study include the completion of questionnaires exclusively by children and not by parents. It can be argued that children know their symptoms better than their parents and may be reluctant to share information regarding bowel movements with their parents while being comfort reporting on an anonymous questionnaire. We cannot rule out the possibility that although our study included multiple cities in various regions, the results may not be generalized to all cities in Colombia. Additionally, concurrent medical diagnoses may be present in surveyed children with or without FGIDs and were not assessed in the study.

In conclusion, this study provides relevant information for public health planning, finding a high prevalence of FGIDs in children of Colombia. Children from private schools and from families whose parents have separated are at higher risk of FGIDs, and nausea is associated with increased rates of FGIDs in children.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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Conflict of interest

The authors declare no conflicts of interest.

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