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ORIGINAL ARTICLE

Prevalence of functional gastrointestinal disorders in Mexican schoolchildren☆

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KEYWORDS
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Abstract
Introduction and aims: Functional gastrointestinal disorders are among the most common chronic disorders in children worldwide. Studies in schoolchildren from various Latin American countries have shown a high prevalence of functional gastrointestinal disorders, but their prevalence in Mexican schoolchildren is unknown. Our aim was to assess the prevalence of functional gastrointestinal disorders in Mexican schoolchildren in accordance with the Rome III criteria.
Material and methods: Children and adolescents from public and private schools in Monterrey and Cuernavaca privately completed the Spanish version of the Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III Version (QPGS-III) in class, using the same methods and questionnaires of previous studies conducted by our group in other Latin American countries.
Results: A total of 362 schoolchildren (public school 82, private school 280), with a mean age of 11.6 ± 2.1 years completed the QPGS-III. Ninety-nine schoolchildren (27.3%) met the criteria for a FGID, according to the Rome III criteria. Functional constipation was the most common FGID (12.6%). Irritable bowel syndrome (6.4%) was the most common FGID associated with abdominal pain. There was no significant difference in the prevalence of FGIDs between sexes (*P*=.8).
Conclusions: We found a high prevalence of FGIDs in Mexican school-aged children and adolescents.

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PALABRAS CLAVE
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México

Prevalencia de trastornos gastrointestinales funcionales en escolares mexicanos

Resumen
Introducción y objetivos: Los trastornos funcionales gastrointestinales se encuentran entre las condiciones crónicas más comunes en niños a nivel mundial. Estudios en escolares de varios países de Latinoamérica mostraron una alta prevalencia de estos trastornos. Nuestro objetivo fue determinar la prevalencia de desórdenes funcionales gastrointestinales en escolares de México de acuerdo con los criterios de Roma III.
Material y métodos: Escolares de escuelas privadas y públicas de Monterrey y Cuernavaca completaron en forma privada la traducción al español del Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III (QPGS-III) en clase usando los mismos métodos que han sido utilizados por nuestro grupo en otros estudios en varios países de Latinoamérica.
Resultados: Un total de 362 niños y adolescentes (escuela pública 84, escuela privada 329) con una edad promedio de 11.6 ± 2.1 años completaron el QPGS-III. Noventa y nueve escolares (27.3%) conformaron los criterios para un trastorno funcional gastrointestinal de acuerdo con los criterios de Roma III. Estreñimiento funcional fue el desorden funcional gastrointestinal más común (12.6%). El síndrome de intestino irritable (6.4%) fue el desorden funcional gastrointestinal asociado con dolor más comúnmente diagnosticado. No encontramos predominio de sexo en la prevalencia de desórdenes funcionales gastrointestinales ($p = 0.8$).
Conclusiones: Los trastornos funcionales gastrointestinales son comunes en niños y adolescentes mexicanos de edad escolar.

Introduction and aims

Functional gastrointestinal disorders (FGIDs) are among the most common chronic disorders in children worldwide.[1–8] FGIDs are associated with low physical, social, and emotional functioning, as well as poorer school performance.[9] Children suffering from FGIDs have lower quality of life scores compared with children with organic diseases such as inflammatory bowel disease (IBD).[2]

The burden on the healthcare budget associated with the care of FGIDS is substantial. FGIDs are the most common cause of pediatric gastroenterology consultations and account for 52% of all such visits.[10] The total annual medical and non-medical costs associated with the care of abdominal pain-related FGIDs (AP-FGIDs) in the Netherlands exceed €2500[10] and the cost of care for AP-FGIDs in children of the US has tripled in 12 years.[11] Although no studies have been conducted on the total economic impact of FGIDs in Latin American countries, it is likely to be considerable.

The pathogenesis of FGIDs is not yet completely understood, but multiple factors are thought to interact in their development. Some of these factors may vary in relation to age and region. Diet, culture, climate, and infectious agents differ from country to country. Comparing the data of children and adults from different countries may help advance the understanding of FGIDs and could provide insight into the interplay of the various factors associated with their pathogenesis. Methodological differences are a shortcoming of many epidemiologic studies. These differences do not allow data to be combined for meta-analyses, thus impeding the comparison of the various factors involved in the pathogenesis of FGIDs.

The Functional International Digestive Epidemiological Research Survey (FINDERS) group was created to establish the epidemiology of FGIDs in Latin American children. Its ultimate goals are to contribute to the better understanding of FGIDs, help raise awareness of FGID prevalence in Latin America, and provide valuable epidemiologic data so that the planning of regional care can be adapted to local needs.

We conducted an epidemiologic study to assess the prevalence of FGIDs in Mexican schoolchildren, using the Spanish version of the Rome III criteria.[12]

Materials and methods

We performed a cross-sectional study on school-aged children and adolescents in Mexico, the largest Spanish-speaking country in Latin America. The study followed the same protocol used by FINDERS in the neighboring countries of Central America and South America.[4,7,13] After the study protocol was reviewed by the director of each participating school, study material packages were mailed to the families of the children and adolescents attending both a private and a public school in 2 different cities selected for reasons of convenience: Cuernavaca, in the State of Morelos, and Monterrey, in the State of Nuevo León. The package included an invitation to participate in the study, a consent form for the parents, and the assent form for the study subjects. Information on the subjects' demographics (age and sex) was collected from the schoolchildren and the medical history was collected from the parents. In class, each subject completed the self-report form of the Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III Version (QPGS-RIII),

Table 1 Demographic characteristics and the presence or absence of functional gastrointestinal disorders.

	Present (n=99) 27.3%	Absent (n=263) 72.7%	Odds Ratio	95% CI	p value
Age groups					
Children (8-12)	63	185	1.00	0.80-2.26	0.22
Adolescents (12-18)	36	78	1.35		
Sex					
Males	52	142	1.00	0.64-1.72	0.80
Females	47	121	1.06		
City					
Monterrey	46	178			
Cuernavaca	53	85			
School Type					
Public	25	57	1.00	0.46-1.47	0.46
Private	74	206	0.81		

the translation of which had been previously validated in Spanish-speaking children.[11,14,15] The study was presented to the schoolchildren by members of the research team that explained the terms used in the QPGS-RIII and were available for questions during the completion of the questionnaires. The data from the QPGS-RIII results were digitally captured to calculate the prevalence of constipation. The Fisher's exact test was used to analyze the data, when appropriate, and the odds ratio was calculated to evaluate the influence of potential risk factors, including age and sex. Statistical significance was set at a p value < 0.05 (Stata 13, StataCorp, College Station, TX, USA). The study was approved by the directors of each of the schools and by the Institutional Review Board of the *Universidad del Valle*, Cali, Colombia.

Results

Four hundred and fifty-one schoolchildren from the third to the eighth grades were invited to participate in the study. Of those subjects, 413 (91.6%) agreed to participate and returned the questionnaires. Fifty-one (12.3%) subjects were excluded due to incomplete or poorly filled out forms, leaving a total of 362 (80.3%) schoolchildren with fully completed questionnaires to be included in the study (fig. 1). Of the study sample, 53.5% were females. The mean age of the schoolchildren was 11.6 ± 2.1 years, with an 8-18 year range. One hundred and thirty-eight schoolchildren studied in Cuernavaca and 224 in Monterrey. Eighty-two of the participants attended public school and 280 went to private school. Table 1 shows the demographic characteristics of the study subjects.

Ninety-nine participants (27.3%) met the criteria for a FGID according to the Rome III criteria. There was no significant difference in FGIDs between children (8-12 years) and adolescents (13-18 years) (Table 2). There was no significant difference in the prevalence of FGIDs between sexes (p = 0.8). AP-FGIDs were diagnosed in 14.1% of the participants. Irritable bowel syndrome (IBS) was the most common AP-FGID, presenting in 6.4% (95% CI 3.84-8.86). Defecation disorders were diagnosed in 12.9% of

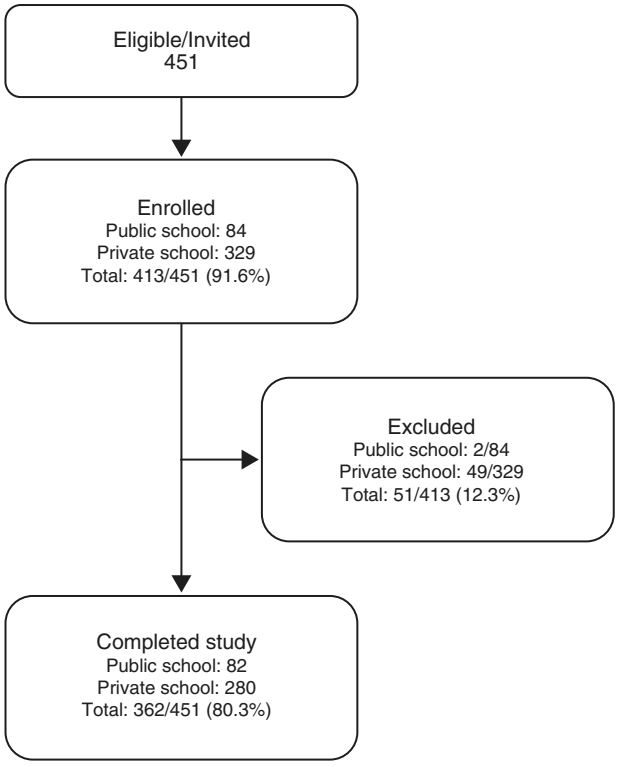

Figure 1 Flow diagram of subject recruitment and inclusion.

the schoolchildren (functional constipation 12.6% [95% CI 9.28-16.12], non-retentive fecal incontinence 0.3% [95% CI −0.26-0.80]). Functional constipation predominated in males (56.3%). The most common features in the subjects with functional constipation were hard stools in 26 (56%), painful stools in 24 (52%), passage of very large stools in 21 (46%), and frequency of fewer than two stools per week in 20 (44%).

Nausea was reported by 12.7% of all schoolchildren and by 21% of those that had a FGID. Nausea was significantly more common in subjects with FGIDs (p = 0.001). Nausea was reported by 50% of the schoolchildren with functional

Table 2 Prevalence of functional gastrointestinal disorders.

Functional gastrointestinal disorders	Number (%)	95% CI
Total	362	n/a
Without FGIDs	263 (72.7)	68.06-77.24
With FGIDs	99 (27.3)	22.75-59.27
Vomiting and aerophagia		
Cyclic vomiting syndrome	1 (0.3)	−0.26-0.80
Abdominal pain-related FGIDs		
Irritable bowel syndrome	23 (6.4)	3.84-8.86
Abdominal migraine	19 (5.2	2.95-7.53
Functional abdominal pain	6 (1.7)	0.34-2.96
Functional dyspepsia	3 (0.8)	−0.10-1.74
Constipation and incontinence		
Functional constipation	46 (12.6)	9.28-16.12
Non-retentive fecal incontinence	1 (0.3)	−0.26-0.80

abdominal pain, 34.7% of those with IBS, 15.7% of the participants with abdominal migraines, 15.2% of those with functional constipation, and 100% of the subjects with cyclic vomiting (there was only one case). None of the participants that had functional dyspepsia reported nausea. Nausea was significantly associated with the diagnoses of IBS (p=0.0001) and functional abdominal pain (p=0.04), but it was not significantly associated with any other FGID.

Discussion and conclusions

This is the first study on the prevalence of FGIDs in Mexican schoolchildren using the Rome III criteria. The study showed that a large number of schoolchildren had FGIDs (27.3%), and AP-FGID was the most common type. The prevalence of IBS found in this study (6.4%) was slightly higher, but close in range, to that found in other studies by our group using the same data collection methods. The IBS prevalence found in other studies by our group was 3.8% in El Salvador,[8] 4.8% in Ecuador,[4] 5.4% in Colombia,[5] and 5.6% in Panama.[16] These results were similar to the prevalence of IBS found in other school studies conducted in Nigeria (5.6%),[6] Sri-Lanka (7%),[1] and Germany (4.9%),[2] using the Rome III criteria. The prevalence of IBS found in our study was similar to the results of a nationwide study on adults in Mexico that reported a prevalence of 7.6% (6.56-8.78%).[17] This is an interesting finding, given that numerous studies on adults (including another study from Mexico[18]) found an IBS prevalence ranging from 10-20%,[19–22] whereas most studies in children found a prevalence between 3 and 7%. These differences in prevalence between children and adults do not seem to be exclusively limited to IBS, but also include post-inflammatory IBS. There is a higher prevalence of IBS in patients with inflammatory disease in adults[23] than in children.[24] Adults with celiac disease seem to present with post-inflammatory IBS as a result of chronic gluten exposure prior to a gluten free diet, but this was not found to be true in children.[25] To the contrary, a single study suggests that the long-term consequences of bacterial post-infectious IBS may be more pronounced in children than in adults. The study showed that 16 years after exposure to *Salmonella*, children had a higher prevalence of IBS, but adults did not.[26] If these differences in prevalence do in fact exist, they should be further investigated. The timing of the shift from a pediatric to an adult pattern could be revealing.

We did not find predominance of either sex to be associated with FGIDs in our sample. A meta-analysis by Lovell and Ford found a female predominance in IBS,[27] but studies from Latin America have shown mixed results. Some studies show an equal distribution of the sexes in FGIDs,[18] whereas others show a female predominance.[17] A better understanding of the reason for these possibly regional differences in predominance by sex in FGIDs could advance our knowledge of the individual influence of the various factors involved in the pathogenesis of FGIDs.

In the past, we have reported a high prevalence of nausea in Latin American children.[28] The average prevalence of nausea in schoolchildren in 3 Latin American countries was 15.9%. We found a fairly similar prevalence of nausea in the present study, with 12.7% of all schoolchildren reporting nausea. However, the current study did not exclude the subjects with organic diseases, as was the case in previous studies conducted by FINDERS. In line with our previous study, nausea was significantly more common in the present study in schoolchildren that had a FGID. Nausea was significantly associated with the diagnoses of IBS and functional abdominal pain, but unexpectedly, it was not associated with functional dyspepsia. A possible explanation for this negative finding was the small number of schoolchildren (n=3) with functional dyspepsia.

The limitations of our study include the absence of information on organic diseases and the lack of information from the parents. The schoolchildren were not tested for celiac disease. A study among healthy blood donors in Mexico found a high prevalence of tTGA positivity (2.6%),[29] thus it is likely that some of the schoolchildren could have celiac disease, which would make it a confounder at the time of analyzing the data. Moreover, a study by Sotelo Cruz et al. on celiac disease in children from Mexico found that approximately 50% of the study participants reported symptoms that could overlap with FGIDs.[30] In addition, the data of the present study cannot be generalized for the entire population of Mexico. The sample had more schoolchildren from private schools than from public schools, and therefore the study may have been conducted on a skewed population with a different prevalence of FGIDs and socioeconomic characteristics.

The strengths of our study include the large sample size and the fact that it was conducted on public and private school students in two different cities. An important aspect of this study is the use of the same methodology as in previous studies by FINDERS, enabling comparisons among different countries.

In conclusion, we found a high prevalence of FGIDs in Mexican schoolchildren. Future prospective studies

identifying children with organic diseases and FGIDs should be conducted to compare the prevalence of symptoms between adults and children in the same cities, as well as the prevalence found in distinct regions and ethnic groups in Mexico.

Ethical responsibilities

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

Data confidentiality. The authors declare that no patient data appear in this article.

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

Financial disclosure

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Conflict of interest

Dr. Saps is and has been a consultant in the last 36 months for Ardelyx, IBGard, Forest, QOL Medical, Quintiles, and Nutricia.

References

1. Devanarayana NM, Adhikari C, Pannala W, et al. Prevalence of functional gastrointestinal diseases in a cohort of Sri Lankan adolescents: Comparison between Rome II and Rome III criteria. J Trop Pediatr. 2011;57:34–9.
2. Gulewitsch MD, Enck P, Schwille-Kiuntke J, et al. Rome III criteria in parents' hands: Pain-related functional gastrointestinal disorders in community children and associations with somatic complaints and mental health. Eur J Gastroenterol Hepatol. 2013;25:1223–9.
3. Hyams JS, Burke G, Davis PM, et al. Abdominal pain and irritable bowel syndrome in adolescents: A community-based study. J Pediatr. 1996;129:220–6.
4. Játiva E, Velasco-Benítez CA, Koppen IJ, et al. Prevalence of functional gastrointestinal disorders in school children in Ecuador. J Pediatr Gastroenterol Nutr. 2016;63:25–8.
5. Saps M, Nichols-Vinueza DX, Rosen JM, et al. Prevalence of functional gastrointestinal disorders in Colombian school children. J Pediatr. 2014;164:542–5, e541.
6. Udoh E, Devanarayana NM, Rajindrajith S, et al. Abdominal pain predominant functional gastrointestinal disorders in adolescent Nigerians. J Pediatr Gastroenterol Nutr. 2015.
7. Varni JW, Bendo CB, Shulman RJ, et al. Interpretability of the PedsQL™ Gastrointestinal Symptoms Scales and Gastrointestinal Worry Scales in pediatric patients with functional and organic gastrointestinal diseases. J Pediatr Psychol. 2015;40:591–601.
8. Zablah R, Velasco-Benítez C, Merlos I, et al. Prevalence of functional gastrointestinal disorders in school-aged children in El Salvador. Rev Gastroenterol Méx (English edition). 2015;80:186–91.
9. Rajindrajith S, Devanarayana NM, Weerasooriya L, et al. Quality of life and somatic symptoms in children with constipation: A school-based study. J Pediatr. 2013;163:1069–72, e1061.
10. Rouster AS, Karpinski AC, Silver D, et al. Functional gastrointestinal disorders dominate pediatric gastroenterology outpatient practice. J Pediatr Gastroenterol Nutr. 2015.
11. Park R, Mikami S, LeClair J, et al. Inpatient burden of childhood functional GI disorders in the USA: An analysis of national trends in the USA from 1997 to 2009. Neurogastroenterol Motil. 2015;27:684–92.
12. Saps M, Velasco C, Nichols-Vinueza D. Validation of the Rome III criteria. High internal consistency of the questionnaire of pediatric gastrointestinal symptoms (Spanish version). J Pediatr Gastroenterol Nutr. 2012;55:E36–7.
13. Saps M, Nichols-Vinueza DX, Mintjens S, et al. Construct validity of the pediatric Rome III criteria. J Pediatr Gastroenterol and Nutr. 2014;59:577–81.
14. Dhroove G, Chogle A, Saps M. A million-dollar work-up for abdominal pain: is it worth it. J Pediatr Gastroenterol Nutr. 2010;51:579–83.
15. Hoekman DR, Rutten JM, Vlieger AM, et al. Annual costs of care for pediatric irritable bowel syndrome, functional abdominal pain, and functional abdominal pain syndrome. J Pediatr. 2015;167, 1103-1108. e1102.
16. Lu PL, Saps M, Chanis RA, et al. The prevalence of functional gastrointestinal disorders in children in Panama: A school-based study. Acta Paediatr. 2016;105:e232–6.
17. Amieva-Balmori M, Meixueiro A, Canton P, et al. Su2059 prevalence of irritable bowel syndrome in Mexico. A Nationwide Population Based Study Using the ROME III Questionnaire. Gastroenterology. 2014;5:S–S535.
18. López-Colombo A, Morgan D, Bravo-González D, et al. The epidemiology of functional gastrointestinal disorders in Mexico: A population-based study. Gastroenterol Res Pract. 2012, 2012.
19. Hungin A, Whorwell P, Tack J, et al. The prevalence, patterns and impact of irritable bowel syndrome: An international survey of 40 000 subjects. Aliment Pharmacol Ther. 2003;17:643–50.
20. Lovell RM, Ford AC. Global prevalence of and risk factors for irritable bowel syndrome: A meta-analysis. Clin Gastroenterol Hepatol. 2012;10, 712-721. e714.
21. Saito YA, Schoenfeld P, Locke GR 3rd. The epidemiology of irritable bowel syndrome in North America: A systematic review. Am J Gastroenterol. 2002;97:1910–5.
22. Thompson W, Irvine E, Pare P, et al. Functional gastrointestinal disorders in Canada: First population-based survey using Rome II criteria with suggestions for improving the questionnaire. Dig Dis Sci. 2002;47:225–35.
23. Minderhoud IM, Oldenburg B, Wismeijer JA, et al. IBS-like symptoms in patients with inflammatory bowel disease in remission; relationships with quality of life and coping behavior. Dig Dis Sci. 2004;49:469–74.
24. Zimmerman LA, Srinath AI, Goyal A, et al. The overlap of functional abdominal pain in pediatric Crohn's disease. Inflamm Bowel Dis. 2013;19:826–31.
25. Saps M, Adams P, Bonilla S, et al. Abdominal pain and functional gastrointestinal disorders in children with celiac disease. J Pediatr. 2013;162:505–9.
26. Cremon C, Stanghellini V, Pallotti F, et al. *Salmonella* gastroenteritis during childhood is a risk factor for irritable bowel syndrome in adulthood. Gastroenterology. 2014;147:69–77.
27. Lovell RM, Ford AC. Effect of gender on prevalence of irritable bowel syndrome in the community: Systematic review and meta-analysis. Am J Gastroenterol. 2012;107:991–1000.
28. Saps M, Velasco-Benítez C, Kovacic K, et al. High prevalence of nausea among school children in Latin America. J Pediatr. 2015;169:98–104.

29. Remes-Troche JM, Ramírez-Iglesias MT, Rubio-Tapia A, et al. Celiac disease could be a frequent disease in Mexico: Prevalence of tissue transglutaminase antibody in healthy blood donors. J Clin Gastroenterol. 2006;40:697–700.

30. Sotelo Cruz N, Calderón de la Barca AM, Hurtado Valenzuela JG. Celiac disease in children from the northwest of Mexico: Clinical characteristics of 24 cases. Rev Gastroenterol Méx (English edition). 2013;78:211–8.