



Is There an Association between Functional Constipation and Excessive Bodyweight in Children?

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Objectives To determine the prevalence of functional constipation, overweight, and obesity in a cross-sectional observational study among children in Colombia and to examine the association between functional constipation and excessive bodyweight in this population.

Study design Demographics, anthropometric data, and questionnaires were collected from 2820 children between 8 and 18 years of age across 4 regions in Colombia. A Spanish translation of the Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III Version was used to determine the prevalence of functional constipation. Anthropometric measurements of weight, height, and body mass index (BMI) were obtained following World Health Organization guidelines; overweight was defined as a BMI z-score (adjusted for sex and age) between 1 and 2, obesity was defined as a BMI z-score >2.

Results A total of 368 children (13.0%) were found to have functional constipation, 542 children (19.2%) were overweight, and 188 children (6.7%) were obese. Functional constipation did not occur more frequently in children who were obese (14.9%) or overweight (13.1%) compared with children with normal weight (12.9%, $P = .73$). The prevalence of functional constipation, overweight, and obesity differed significantly between regions. Functional constipation and excessive bodyweight were significantly more common in children attending private schools compared with children attending public schools.

Conclusions Functional constipation, overweight, and obesity are commonly observed in children in Colombia. No association between functional constipation and overweight or obesity was found. (*J Pediatr* 2016;171:178-82).

Childhood overweight and obesity are challenging problems faced by pediatricians worldwide.¹ In 2013, in developed countries, the prevalence of overweight and obesity was 23.8% in boys and 22.6% in girls.¹ Although the prevalence of overweight and obesity is traditionally lower in developing countries, it has increased strikingly between 1980 and 2013; from 8.1% to 12.9% for boys and from 8.4% to 13.4% in girls.¹ Obesity in children is commonly known to be a risk factor for a wide variety of severe chronic diseases, including type 2 diabetes and fatty liver disease, and is associated with increased healthcare costs.²

In developed countries, several pediatric studies have revealed an association between excessive bodyweight and functional constipation in children.³⁻⁷ Functional constipation is a common pediatric healthcare problem worldwide, with a reported prevalence ranging from 0.7%-29.6%.⁸ The diagnosis is based on the Rome III criteria, and symptoms may include infrequent, painful defecation, hard stools, and fecal incontinence.⁹ These bothersome symptoms are known to have a significant impact on the quality of life of affected children.¹⁰⁻¹³ Despite its common occurrence, the pathophysiology of functional constipation is still incompletely understood.¹⁴ The underlying mechanisms behind the suggested association between functional constipation and overweight also remain unidentified. Factors such as dietary intake, physical activity, the gut microbiota, psychological factors, and socioeconomic status may play a role in the pathophysiology of both disorders and could account for their commonly reported co-occurrence. Studies regarding the association between functional constipation and excessive bodyweight have mostly been conducted in developed countries. Since pathophysiological factors may differ between developing and developed countries, it is of key importance to conduct such studies also in developing countries, to evaluate if results from studies from developed countries are indeed applicable to the pediatric population in developing countries.

The primary aim of this population-based, cross-sectional observational study was to assess the prevalence of functional constipation, overweight, and obesity in children across multiple regions of Colombia and to assess the association between excessive bodyweight and functional constipation. Secondary aim was to

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BMI	Body mass index
QPGS-RIII	Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III Version
WHO	World Health Organization

assess whether other factors such as socioeconomic factors or family composition are associated with functional constipation or excessive bodyweight in children.

Methods

The design of this study was based on previous studies in school children, performed and described by our group.^{15,16} In short, between February and October 2014, an invitation package was sent to the families of 4093 children between 8 and 18 years of age attending schools in 4 main regions of Colombia's mainland; the Andean region (the mountains), the Caribbean region (adjacent to the Caribbean Sea), the Pacific region (adjacent to the Pacific Ocean), and the Amazon region (tropical rainforest). Children were invited through the Obesity and Overweight monitoring program (Programa de Seguimiento de la Obesidad y del Sobrepeso) by the Gastrohnp Research Group at the University del Valle (Cali, Colombia) and the Functional International Digestive Epidemiological Research Survey program. Parents gave written informed consent and all children provided assent to participate. A screening questionnaire was completed by the parents to identify and exclude children who had a history of known organic medical conditions. Children who were underweight (body mass index [BMI] z-score < -2) were excluded from further analyses because of the possibility of undiagnosed organic diseases. Children were also excluded from the analyses if they had a diagnosis of another functional gastrointestinal disorder (not functional constipation) and if missing data hindered the calculation of the BMI z-score or determination of the occurrence of functional gastrointestinal disorders. The Ethics Committee of Clinical Investigation from the University del Valle (Cali, Colombia) and local school authorities approved the study.

Demographic data were obtained through questionnaires. Anthropometric measurements of weight, height, and BMI were obtained following World Health Organization (WHO) guidelines¹⁷; weight (in kilograms) was measured with the child standing on an electronic scale, height (in centimeters) was measured using an adjustable stadiometer. BMI was calculated as weight in kilograms divided by the square of the height in meters (kg/m^2). BMI z-scores were corrected for age and sex and used to define weight categories according to the WHO cut-off values¹⁸; BMI z-scores below -2 were considered underweight, between -2 and +1 as normal weight, between +1 and +2 as overweight, and above +2 as obesity.

A Spanish translation of the Questionnaire on Pediatric Gastrointestinal Symptoms–Rome III Version (QPGS-RIII) was used to diagnose functional constipation and other functional gastrointestinal disorders. The QPGS-RIII is a validated questionnaire for diagnosing functional gastrointestinal disorders in children. The use of the Spanish translation of the QPGS-RIII has been previously described.¹⁹ To ensure children's comprehension, the investigators reviewed the questionnaire with the children during a presentation

before administration and a member of the research team was available for questions while the participants completed the questionnaire.

Data were analyzed using independent samples *t* test, Pearson χ^2 , and Fisher exact test where appropriate using IBM SPSS Statistics for Windows v 22.0 (IBM Corporation Armonk, New York). When comparing the means of multiple groups, 1-way ANOVA with post-hoc analyses applying Bonferroni corrections was used when there was the assumption of homogeneity of variance, the Games-Howell test was used when homogeneity of variance was not assumed. *P* values of <.05 were considered statistically significant.

Results

In total, 2820 children (51.7% boys) between 8 and 18 years of age were included; a flowchart of the inclusion process is depicted in the **Figure** (available at www.jpeds.com). The mean age was 12.1 years (SD 2.3); 1660 (58.9%) were school children between 8 and 12 years of age, and 1160 (41.1%) were adolescents between 13 and 18 years of age. The majority of children (88.4%) attended public schools. The mean age of children in public schools was 12.3 years (SD 2.3) compared with 10.41 years (SD 1.6) in children attending private schools ($P < .01$). The mean age of children differed significantly between regions ($P < .01$); children in the Amazon region had a mean age of 13.5 years (SD 2.2), and they were significantly older than the rest of the children in the Andes (11.8 years of age, SD 2.4), the Atlantic region (12.0 years of age, SD 1.9), and the Pacific region (11.9 years of age, SD 2.4).

Based on their BMI z-scores, 542 children (19.2%, 95% CI 17.8-20.7) were overweight, and 188 children (6.7%, 95% CI 5.8-7.7) were obese. There were significant differences in the prevalence of overweight and obesity between boys and girls; overweight occurred more frequently in girls and the prevalence of obesity was higher in boys (**Table**). Overweight and obesity were significantly more prevalent in school children compared with adolescents; 21.7% vs 15.6% and 8.7% vs 3.7%, respectively ($P < .01$). There were significant differences in the prevalence of overweight and obesity among regions across the country (**Table**). In accordance with these results, the mean BMI z-score differed significantly between regions; the mean BMI z-score was lowest in the Amazon (0.0, SD 1.0) and highest in the Pacific region (0.5, SD 1.1).

Based on the questionnaire, 368 children (13.0%, 95% CI 11.9-14.3) were found to have functional constipation according to the Rome III criteria. There was no significant difference in prevalence of functional constipation between boys and girls. Functional constipation was significantly more prevalent in school children compared with adolescents (14.9% vs 10.4%) and was significantly more prevalent in children attending private school compared with children attending public school (20.4% vs 12.1%; **Table**). The prevalence of functional constipation differed significantly

Table. Prevalence of overweight, obesity, and functional constipation

	Overweight, n = 542	Obesity, n = 188	P value	Functional constipation, n = 368	P value
Sex, n (%)					
Boys	260 (17.8)	110 (7.5)		189 (13.0)	
Girls	282 (20.7)	78 (5.7)	.04*	179 (13.2)	.91†
Age					
School children, n (%)	361 (21.7)	145 (8.7)		247 (14.9)	
Adolescents, n (%)	181 (15.6)	43 (3.7)	<.01*	121 (10.4)	.01†
Mean age (SD)	11.8 (2.1)	11.2 (2.0)	<.01‡	11.5 (2.3)	<.01§
School type, n (%)					
Private	96 (29.3)	34 (10.4)		67 (20.4)	
Public	446 (17.9)	154 (6.2)	<.01*	301 (12.1)	<.01†
Prevalence per region, n (%)					
Pacific	170 (22.1)	79 (10.3)		58 (7.5)	
Atlantic	200 (20.9)	59 (6.2)		129 (13.5)	
Andes	121 (15.6)	41 (5.3)		119 (15.4)	
Amazon	51 (16.0)	9 (2.8)	<.01*	62 (19.4)	<.01*

*Pearson χ^2 .

†Fisher exact test (2-sided).

‡One way ANOVA, Games Howell: the mean age of all 3 weight categories differ significantly from each other.

§Independent samples *t* test.

among regions (Table). The highest prevalence of functional constipation was found in the Amazon region (19.4%), and the lowest prevalence was found in the Pacific region (7.5%). A diagnosis of functional constipation was made in 12.9% of normal-weight children, 13.1% of overweight children, and 14.9% of obese children and this difference was not statistically significant ($P = .73$). Additional analyses comparing children with a BMI z-score >1 (overweight and obese children combined) with normal-weight children also did not reveal a significant difference between these 2 groups ($P = .66$). In addition, 19 children had a BMI z-score ≥ 3 ; analysis revealed that functional constipation was not significantly more prevalent in this group (1/19 had functional constipation).

Family factors such as being an only child, being the first-born, or having divorced or separated parents were not associated with a significant difference in prevalence of functional constipation, overweight, or obesity.

Discussion

This study was performed in Colombia, a developing country in South America. Unlike previous studies conducted in developed countries, we did not find an association between functional constipation and excessive bodyweight in children. The prevalence rates of functional constipation, overweight, and obesity found in this study are comparable with previous results from Colombia; Saps et al¹⁹ reported the prevalence of childhood functional constipation to be 14% in the Colombian city Pasto, and LeBlanc et al reported that 23% of Colombian children are overweight or obese based on their BMI z-score according to the WHO cut-off values.²⁰ Our results regarding the association between functional constipation and overweight or obesity are also comparable with a population-based study by Costa et al,²¹ assessing the association between functional constipation

and excessive bodyweight in 1077 adolescents (10-18 years) in Brazil. They found a comparable prevalence of functional constipation in children with excessive bodyweight and children with normal weight (19.4% and 18.0%, respectively). The results of our study and the study performed by Costa et al²¹ differ from those of a population-based survey study that was conducted in the US, among 450 children (4-18 years of age).³ This study demonstrated that functional constipation was significantly more prevalent in overweight and obese children (23%) than in normal-weight children (13.9%). This difference between 2 South-American studies from developing countries and the study conducted in the US raises questions whether there is a difference between children with excessive bodyweight in South-America compared with the US regarding their susceptibility to functional constipation. Genetics, lifestyle, diet, socioeconomic, and other factors may play an important role and a better understanding of these factors may help to explain these differences. In addition, most studies demonstrating an association between functional constipation and excessive bodyweight have been performed in hospital settings. Two other population-based studies were also unable to demonstrate an association between functional constipation and excessive bodyweight in children,^{21,22} which suggests that children in hospital settings may not reflect the general population well enough to generalize those findings.

Our results contradict the hypothesis that functional constipation is associated with excessive bodyweight in children. In contrast, our results show that in the Pacific region, where the prevalence of functional constipation was the lowest, the prevalences of overweight and obesity were the highest compared with the other regions, and vice versa, in the Amazon, the region with the lowest prevalence of obesity and the second-lowest prevalence of overweight, the prevalence of functional constipation was the highest. Furthermore, the prevalences of both functional constipation and excessive bodyweight varied strongly between regions. These

differences between regions could be caused by dietary, cultural, and socioeconomic factors between the regions. However, the current study was designed to assess the association between bodyweight and functional constipation and did not take into account additional information to assess these differences between regions in more detail.

The prevalence of functional constipation was higher in school children (8-12 years of age) compared with adolescents (13-18 years of age). This may be due to the natural course of functional constipation; symptoms may resolve with age or children may have received treatment for their symptoms, resulting in a lower prevalence in adolescents. Similar to the results found for functional constipation, there was also a significant age difference between normal weight, overweight, and obese children; children who were overweight or obese were significantly younger than normal weight children. Possibly, adolescents are better capable of recognizing and addressing their weight problem or age differences may be the effect of treatment over time, as with functional constipation.

In Colombia, most children attend free public schools and only a minority of children attend more expensive private schools. Our results show that children attending private school suffered from functional constipation, overweight, and obesity significantly more often compared with children attending public schools. These results may have been influenced by age because children in private school were significantly younger than children in public school. Another explanation could be that functional constipation, overweight, and obesity are more common in this population because of lifestyle factors such as a Western diet with low fiber and a sedentary lifestyle, which are likely to be more common in more affluent families. An association between functional constipation and these factors has been suggested in the literature,²²⁻²⁴ although it has been disputed as well.²⁵ On the other hand, the association between lifestyle factors and the prevalence of overweight and obesity has been well established.²⁶⁻³⁰ Because these lifestyle factors are likely related to both overweight and functional constipation, they might explain the previously reported association between functional constipation and overweight in studies conducted in developed countries, where these factors are likely to be more prevalent than in developing countries.

One of the limitations of this study is that we did not obtain detailed information about possible influencing factors such as dietary intake, physical activity, and sedentary time. This might have been useful in identifying possible factors that may have contributed to the regional differences in both functional constipation and overweight. Also, no information was obtained regarding medication that influences gastrointestinal motility, which may have biased our results. Furthermore, functional constipation was diagnosed based on a Spanish translation of the QPGS-RIII and did not include a physical examination with a digital rectal examination. According to the most recent guidelines,³¹ in children who meet one of the

Rome III criteria based on medical history, a physical examination may provide evidence that a child fulfils 2 Rome III criteria, by detection of a fecal mass in the rectum. However, performing a physical examination with digital rectal examination in a population-based study among mostly healthy children is not ethically acceptable. Furthermore, there is a risk of selection bias in this study; because the response rate of the study was extremely high (90.3%), the risk of selection bias because of children declining to participate seems small. The total number of children excluded for being underweight was relatively small compared with the total amount of children, and, therefore, the risk of bias seems acceptable.

In conclusion, functional constipation, overweight, and obesity are common disorders among children in Colombia. This study did not provide evidence for an association between functional constipation and overweight and/or obesity in Colombian children. The results of our study differ from previous studies conducted in developed countries that found an association between functional constipation and excessive bodyweight in children. Future studies should be performed to confirm our findings and investigate the different factors that could explain the differences found between our study and previous studies and the differences between studies conducted in developed and developing countries. We found great variability in prevalence of functional constipation, overweight, and obesity across different regions. Studies aimed at investigating the different socioeconomic, ethnic, dietary, and lifestyle variables of each region may provide important insights into the possible influence of each of these factors in the pathogenesis of functional constipation, overweight and obesity. ■

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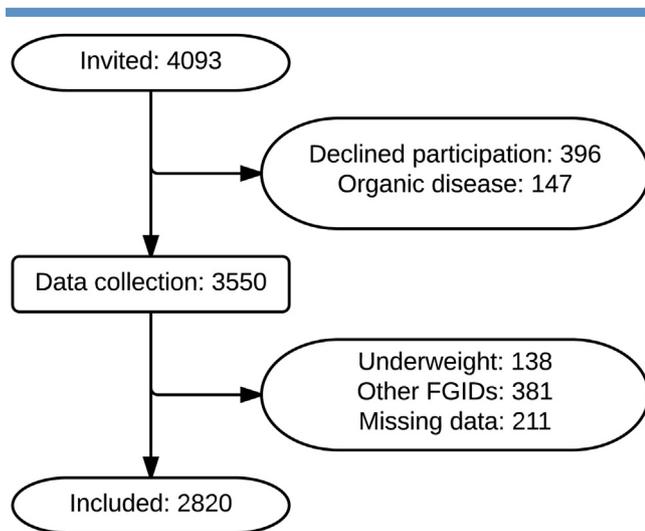


Figure. Flowchart depicting inclusion process of the study. *Other FGIDs*, functional gastrointestinal disorders other than functional constipation.
