Received: 2 October 2023 | Accepted: 24 October 2024

DOI: 10.1002/jpr3.12157

ORIGINAL ARTICLE

Gastroenterology

Efficacy of low FODMAP diet in pediatric patients with disorders of gut–brain interaction

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Funding information

None

Abstract

Objectives: Disorders of gut–brain interaction (DGBIs), including irritable bowel syndrome (IBS), are common among children. Although a diet that is low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP) has been proven to help adults with IBS, there is conflicting evidence of its efficacy in pediatric patients.

Methods: This was a retrospective chart review of pediatric patients with DGBIs diagnosed by a pediatric gastroenterologist between December 2018 and April 2022 and referred to a dietician for low FODMAP diet (LFD). The diagnosis was based on Rome IV criteria, and the chart review was based on International Classification of Diseases 10 diagnosis codes for DGBIs. Subjective historical assessment was used to define symptom improvement. The causative FODMAP Monash group(s) were identified during the reintroduction phase based on a symptom diary.

Results: A total of 58 patients were initially identified (38 females), 47 of whom completed the LFD and followed up. This included 24 patients with IBS-diarrhea predominant (IBS-D), 10 patients with IBS-mixed type (IBS-M), 6 patients with IBS-constipation predominant (IBS-C), and 7 patients with functional abdominal pain (FAP) or functional dyspepsia (FD). Symptom improvement occurred in 22 (91.6%) of IBS-D, 7 (70%) of IBS-M, 3 (50%) of IBS-C, and 3 (42.8%) of FAP/FD. Fructans, garlic, onions, and lactose were the most common offenders.

Conclusion: LFD improves symptoms in most patients with DGBIs, particularly those with IBS-D.

KEYWORDS

functional gastrointestinal disorders, fructans, irritable bowel syndrome

1 | INTRODUCTION

Disorders of gut–brain interaction (DGBIs), previously known as functional gastrointestinal disorders, including irritable bowel syndrome (IBS), functional abdominal pain (FAP), and functional dyspepsia (FD), are present in approximately 27% of children.[1]

Patients with IBS report more food-related symptoms than unaffected children, and more than 50% of these patients report improvement upon dietary removal of the

Abbreviations: DGBIs, disorders of the gut–brain interaction; FAP, functional abdominal pain; FD, functional dyspepsia; FODMAP, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols; GOS, galacto-oligosaccharides; IBS, irritable bowel syndrome; IBS-C, irritable bowel syndrome with constipation; IBS-D, irritable bowel syndrome with diarrhea; IBS-M, irritable bowel syndrome-mixed type; ICD, International Classification of Diseases; LFD, low FODMAP diet.

offending agent.[2] Typically, those foods known to cause these symptoms are fermentable oligo-, di-, monosaccharides, and polyols (FODMAPs). These include wheat, several vegetables, galacto-oligosaccharides (found in most legumes), lactose, fructose (including high-fructose corn syrup), sorbitol, mannitol, and xylitol (found in most sweeteners).[3,4] FODMAPs result in IBS symptoms due to increased small bowel osmolar activity and increased colonic gas production.[3–5]

A recent American Gastroenterological Association clinical practice update and expert review on the role of diet in adults with IBS concluded that "the low-FODMAP diet is currently the most evidence-based diet intervention for IBS."[6] However, a position paper from the European Society of Pediatric Gastroenterology Hepatology and Nutrition concluded that there was insufficient pediatric-specific data to routinely recommend the use of a low FODMAP diet (LFD) to treat functional gastrointestinal disorders.[3]

The aim of this study is to describe a single-center experience in managing children with DGBIs using an LFD.

What is Known

- A low FODMAP diet (LFD) has been proven effective for adults with (DGBIs).
- There is conflicting data on the efficacy of the LFD in children.

What is New

- LFD improves symptoms in most patients with DGBIs, particularly those with IBS-D.
- Data on weight changes with LFD leading to ARFID is limited.

2 | METHODS

This retrospective chart review included patients seen by the dietician at the outpatient pediatric gastroenterology center of The Unterberg Children's Hospital between December 2018 and April 2022. Pediatric patients with DGBIs were identified using International Classification of Diseases (ICD) 10 codes for all forms of IBS, abdominal pain, FAP, or FD. Patients were only included if chart review confirmed they were diagnosed by the pediatric gastroenterologist with a DGBI based on Rome IV criteria[7] before consultation by the dietician. Diagnosis was made based on history, physical exam, and when indicated, laboratory testing, imaging, or endoscopy. Data extraction included the patient's age, gender, DGBI diagnosis, subjective determination of improvement on the diet, and the offending LFD Monash groups.

The clinical workflow is depicted in Figure 1. Upon diagnosis of a DGBI by the pediatric gastroenterologist, a shared decision-making process discussed management options, including cognitive behavioral therapy, medications, or LFD. Those patients who agreed to LFD were referred to the dietician. The evaluation was performed by a single registered dietitian with additional education in counseling patients and their families on an LFD. Initial assessment by the dietician included an assessment of baseline symptoms and typical dietary intake. Symptom assessment included the presence of abdominal pain, bloating, nausea, stool consistency, and frequency. Patients were asked to identify specific trigger foods. Education was provided about the "Monash App" and LFD, including its components and grocery replacements. The dietary

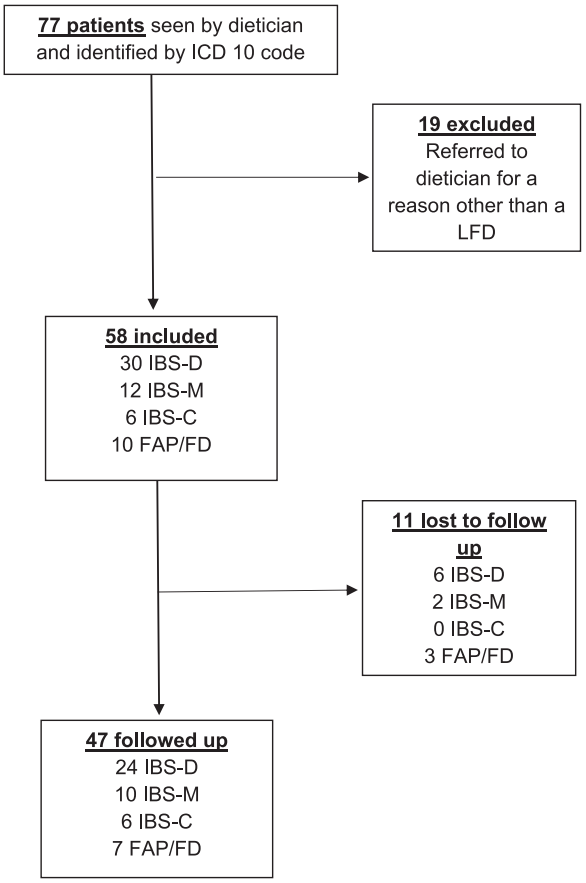

FIGURE 1 Clinical workflow for patients. FAP, functional abdominal pain; FD, functional dyspepsia; FODMAP, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols; IBS-C, irritable bowel syndrome with constipation; IBS-D, irritable bowel syndrome with diarrhea; IBS-M, irritable bowel syndrome-mixed type; ICD, International Classification of Diseases; LFD, low FODMAP diet.

information made available to the parents has been adapted to pediatrics by a registered dietitian based on Monash University, Australia adult FODMAP resources.[9] Patients were asked to initiate and maintain the LFD until a follow-up visit in 3–4 weeks. During the follow-up visit, subjective improvement in

symptoms was assessed. If there was a notable improvement, patients were then instructed how to gradually reintroduce various Monash groups one at a time. During the reintroduction phase, patients kept a symptom diary, recording their gastrointestinal symptoms associated with the consumption of a predetermined quantity of the FODMAP group. At the third visit, after the 4-week reintroduction phase, the symptom diary was reviewed. Carbohydrate intolerance was determined during the reintroduction phase based on the exacerbation of symptoms during the challenge.

Based on this data, a maintenance diet was determined. A final visit assessing the success of the maintenance diet occurred after 1–3 months or as needed. The success of the maintenance diet was based on subjective improvement in pain symptoms, stool frequency and consistency, and quality of life, including the number of school days missed and improvement in general well-being.

The study was granted exempt status by the Institutional Review Board at the Monmouth Medical Center, Long Branch, NJ, based on its retrospective design.

3 | RESULTS

A total of 77 patient charts were reviewed, 58 patients were included, and 47 completed the diet and followed up (Figure S1). The number of patients categorized into each DGBI group, sex and age among those initially included are included in Table 1, which reveals a mean age of 14 years and a female majority.

Table 2 reveals the number of patients with symptomatic improvement based on DGBI type. Data are included for those who followed up, as well as data for those initially included, assuming that those lost to follow-up were nonresponders. Among those classified as nonresponders to the diet, five initially improved but later experienced a recurrence of symptoms (two with IBS-M, one with IBS-C, and two with FAP/FD).

Intolerance was demonstrated during the reintro duction phase of the diet, with most patients exhibiting symptoms to multiple carbohydrate groups. Among the 47 patients on the LFD diet with follow-up, the highest intolerance was observed for fructans affecting 34 patients (72.3%). Table 3 provides detailed data on symptom-inducing Monash groups.

TABLE 1 Included patient's DGBI distribution, age, and sex.

DGBI type (*N* = 58)	*N* (%)	Mean age (range) years	Females *N* (%)
IBS (all types)	48 (82.8)	14 (9–21)	31 (64.5)
IBS-D	30	14	18
IBS-M	12	15	9
IBS-C	6	13	4
FAP/FD	10 (17.2)	15.4 (12–19)	7 (70)

Abbreviations: DGBI, disorders of the gut–brain interaction; FAP, functional abdominal pain; FD, functional dyspepsia; IBS, irritable bowel syndrome; IBS-C, irritable bowel syndrome with constipation; IBS-D, irritable bowel syndrome with diarrhea; IBS-M, irritable bowel syndrome-mixed type.

TABLE 2 Symptom improvement based on DGBI.

DGBI	Symptom improvement in the group that followed up *N*/total (%)	Symptom improvement in the group initially included *N*/total (%)
IBS (all types)	32/40 (80)	32/48 (66.7)
IBS-D	22/24 (91.6)	22/30 (73.3)
IBS-M	7/10 (70)	7/12 (58.3)
IBS-C	3/6 (50)	3/6 (50)
FAP/FD	3/7 (42.8)	3/10 (33.3)
Total	35/47 (74.5)	35/58 (60.3)

Abbreviations: DGBI, disorders of the gut–brain interaction; FAP, functional abdominal pain; FD, functional dyspepsia; IBS, irritable bowel syndrome; IBS-C, irritable bowel syndrome with constipation; IBS-D, irritable bowel syndrome with diarrhea; IBS-M, irritable bowel syndrome-mixed type.

TABLE 3 Common Monash groups causing symptoms among the 47 patients that followed up.

FODMAP Monash group	*N* (%)
Fructans	34 (72.3)
Garlic and onion	13
Fructan grains	9
Fructan grains plus garlic and onions	12
Lactose	24 (51)
Sorbitol/polyols	13 (27.6)
Fructose	12 (25.5)
Galactans/GOS	5 (10.6)

Abbreviations: FODMAP, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols; GOS, galacto-oligosaccharides.

4 | DISCUSSION

This real-world clinic-based retrospective cohort study found the LFD to be highly effective in treating pediatric DGBIs. Overall, 35 of the 47 patients that followed up (74.5%) experienced symptom improvement. This was particularly notable in patients with IBS and some components of diarrhea. Among those who followed up, 91.6% of the IBS-D group and 70% of the IBS-M group reported symptom improvement compared to only 50% of the IBS-C and 42.8% of the FD/FAP groups. Furthermore, the data revealed that multiple FODMAPs could trigger symptoms in individuals, with fructans (e.g., garlic and onions) and lactose being the most common offenders.

The outcomes of this study align with those from studies performed in adults with IBS. They describe improvement with bloating, abdominal pain, and flatulence.[8] Prior studies reveal common FODMAP group intolerances to be rich in fructans and lactose.[8–10]

A retrospective study of 29 children revealed resolution of bloating in 92%, diarrhea in 87%, and abdominal pain in 77%. Similar to our findings, fructans were the most common symptom-inducing carbohydrates.[3] An open-label study of 20 patients with pain-related DGBIs reported a decrease in pain-related complaints from 2 per day to 1.16, along with a corresponding reduction in pain intensity.[10]

However, not all prior studies have yielded positive results. A double-blind crossover trial of 33 children with IBS revealed that 8 (24.2%) were responders, 15 (45.5%) were nonresponders, and 10 (30.3%) were "placebo-responders."[11] Similarly, a second double-blind, placebo-controlled trial in 29 children with FAP, showed an improvement trend that did not reach statistical significance, reflecting our finding that LFD is less effective for those patients with pain, but no diarrhea.[12]

Implementing restrictive diets, especially in pediatric patients, is challenging. We observed a dropout rate of 19%, likely reflecting this difficulty. Practitioners must be mindful of the nutritional implications of a therapeutic diet for children. To prevent alterations in nutritional status, LFD should be supervised by a skilled dietitian who can carefully restrict and reintroduce specific foods from core food groups in a short-term period.[13]

LFD is not a long-term solution for managing IBS, as prolonged restriction of major food groups can lead to alterations in the gut flora.[13–15] Adhering to the restrictive phase of LFD beyond the intended period can reduce the presence of *Bifidobacterium* in the gut lumen, which may exacerbate IBS symptoms.[13]

Our study was limited by its retrospective data collection approach. Additionally, symptom improvement was assessed subjectively, and a relatively large number of patients were lost to follow-up. No control group was available in the study to assess the possibility of a placebo response. Given that PEG 3350 is typically the preferred treatment for IBS-C, and proton pump inhibitor is the preferred treatment for functional dyspepsia, there may have been a selection bias that led to the referral of a greater percentage of IBS-D patients for LFD. Further, the dietician may have been biased in their subjective assessment of the success of the LFD as they were not blinded to the specific DGBI diagnosis. Despite these limitations, our study has several strengths. As this was a clinic-based study, patients were managed by the same pediatric gastroenterologist and dietitian. With the assistance of a specialized dietician, we maintained the restrictive phase for a shorter duration, minimizing potential nutritional deficiencies.

Future studies can help to better define which patients are most likely to respond to an LFD, as well as address the possibility of a "step-up approach" in which only fructans and lactose are eliminated initially thereby easing the elimination phase. Additionally, studies can address the minimum time required to observe for improvements to limit dietary restrictions. Lastly, long-term studies are necessary to determine whether these "intolerances" are lifelong.

5 | CONCLUSION

LFD can improve symptoms in patients with DGBIs, particularly those with IBS-D.

ACKNOWLEDGMENTS

The study was not supported by any funding or grant.

CONFLICT OF INTEREST STATEMENT

Dr Jonathan E. Teitelbaum receives royalties from UpToDate. The remaining authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Raja S, Teitelbaum JE, Pereira K, Guli K, Schosheim A. Efficacy of low FODMAP diet in pediatric patients with disorders of gut–brain interaction. *JPGN Rep*. 2025;6:75-79. doi:10.1002/jpr3.12157