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Impact of a low-FODMAPs diet on gastrointestinal symptoms of patients diagnosed with irritable bowel syndrome: a systematic review of the literature

**Impacto de uma dieta com baixo teor de FODMAPs nos
sintomas gastrointestinais de pacientes diagnosticados com
a síndrome do intestino irritável: uma revisão sistemática
da literatura**

Abstract

Introduction: Irritable bowel syndrome (IBS) is a chronic functional intestinal disorder, characterized by recurrent abdominal pain and changes in bowel habits, without clear organic causes. As its etiology is not yet fully understood, there is no treatment universally applicable to all patients. However, the exclusion of FODMAPs (*fermentable oligosaccharides, disaccharides, monosaccharides, and polyols*) from the diet has been studied as a potential strategy to treat the symptoms of the disease. **Objective:** This study aimed to investigate the effects of low FODMAPs diet (LFD) on gastrointestinal symptoms of patients diagnosed with IBS. **Method:** This is a systematic review of the literature in the databases PubMed, Lilacs, Medline, Virtual Health Library (VHL), ScienceDirect, and Embase, using combinations of descriptors based on the PICO strategy. Eleven randomized controlled trials published in the last ten years (2013-2023) with adults diagnosed with IBS were selected. Studies employing dietary interventions other than a low FODMAP diet (LFD), those involving patients with different intestinal disorders, and those that did not assess gastrointestinal symptoms were excluded. **Results:** LFD proved to be effective in reducing IBS symptoms, promoting a remarkable decrease in the intensity and frequency of abdominal pain and distension. However, patients following LFD had lower energy and fiber intake, suggesting the need for nutritional monitoring. In addition, the adoption of this diet resulted in a decrease in the population of Bifidobacterium, due to fiber exclusion. **Conclusion:** This study supports that LFD is an effective nutritional strategy to relieve gastrointestinal symptoms in adults with IBS.

Keywords: Irritable colon syndrome. Irritable colon. FODMAP-restricted diet.

Resumo

Introdução: A síndrome do intestino irritável (SII) é um distúrbio intestinal funcional crônico, caracterizado por dor abdominal recorrente e alterações nos hábitos intestinais, sem causas orgânicas claras. Como sua etiologia ainda não é totalmente compreendida, não há um tratamento universalmente

aplicável a todos os pacientes. No entanto, a exclusão de FODMAPs (*fermentable oligosaccharides, disaccharides, monosaccharides, and polyols*) da dieta tem sido estudada como potencial estratégia para tratar os sintomas da doença. **Objetivo:** Este estudo objetivou investigar os efeitos da dieta com baixo teor de FODMAPs (DBTF) nos sintomas gastrointestinais de pacientes diagnosticados com SII. **Método:** Trata-se de uma revisão sistemática da literatura nas bases de dados PubMed, Lilacs, Medline, Biblioteca Virtual em Saúde (BVS), ScienceDirect e Embase, utilizando combinações de descritores com base na estratégia PICO. Foram selecionados 11 ensaios controlados randomizados publicados nos últimos dez anos (2013-2023), com adultos diagnosticados com SII. Foram excluídos estudos que utilizaram outras intervenções dietéticas além da DBTF, aqueles realizados com pacientes diagnosticados com outros distúrbios intestinais e que não avaliaram sintomas gastrointestinais. **Resultados:** A DBTF se mostrou eficaz na redução dos sintomas da SII, promovendo uma diminuição notável na intensidade e frequência da dor abdominal e distensão. No entanto, os pacientes seguindo a DBTF apresentaram menor ingestão de energia e fibras, sugerindo a necessidade de acompanhamento nutricional. Ademais, a adoção dessa dieta resultou na diminuição da população de *Bifidobacterium*, devido à exclusão de fibras. **Conclusão:** Este estudo sustenta que a DBTF é uma estratégia nutricional eficaz para aliviar sintomas gastrointestinais em adultos com SII.

Palavras-chave: Síndrome do cólon irritável. Cólon irritável. Dieta restrita em FODMAP.

INTRODUCTION

Irritable bowel syndrome (IBS) is a chronic multifactorial functional disorder, more prevalent in young women, up to 49 years of age.¹ In Brazil, 10-15% of the population is affected, with the incidence decreasing after 60 years.²

Its etiology, though not entirely understood, involves pathophysiological changes such as altered intestinal motility, visceral hypersensitivity, low-grade intestinal inflammation, increased intestinal permeability, dysregulation of the brain-gut axis, microbiota imbalance, abnormal gas production, as well as genetic predisposition and psychosocial factors.^{1,3}

Symptoms of IBS include recurrent abdominal pain or discomfort, combined with changes in bowel patterns, including variations in the frequency and consistency of stool.⁴ In addition, patients may have psychological symptoms such as irritability, depression, anxiety, fatigue, and insomnia, significantly affecting their quality of life.⁵

Because it is a functional disorder, patients with IBS do not present visible structural impairments identified by tests such as endoscopy, radiography, biopsy, or biochemistry, which are requested to discard any organic cause.^{6,7} Thus, the diagnosis is based on excluding other intestinal disorders and the Rome IV criteria, as defined by the Rome Foundation. These criteria diagnose IBS in the presence of frequent abdominal pain occurring at least once a week over the last three months, with recurrent onset for more than six months. Additionally, the diagnosis requires two of the following symptoms: pain that worsens or improves with defecation, changes in stool frequency, and alterations in stool form as classified by the Bristol Stool Scale.¹

Given the lack of consensus on the cause of IBS, there is still no universally applicable treatment for all patients. A nutritional strategy that has proven effective in its therapeutics is reducing the intake of FODMAPs - fermentable oligosaccharides, disaccharides, monosaccharides, and polyols - a group of short-chain carbohydrates.^{2,6}

The low FODMAPs diet (LFD) implies the restriction of foods rich in fermentable carbohydrates for a period of four to six weeks. Foods rich in fiber and sources of macro and micronutrients, such as onions, cabbage, beets, broccoli, peas, wheat by-products, milk, and its derivatives, as well as fruits like apples, watermelons, pears, mangoes, and others, are excluded from the diet. Subsequently, these are gradually reintroduced to assess long-term tolerance and control of symptoms.^{1,8}

In this sense, the development of studies that contribute to the progress of treatment and improve the quality of life of people with IBS is extremely relevant, both for the clinical practice of nutritionists and other health professionals as well as for science.

Thus, the aim of this study was to investigate the effects of a low FODMAPs diet (LFD) on gastrointestinal symptoms of patients diagnosed with irritable bowel syndrome (IBS).

METHOD

This is a systematic literature review based on the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA 2020),⁹ with the following guiding question: "A low FODMAPs diet (LFD) reduces gastrointestinal symptoms in patients diagnosed with irritable bowel syndrome (IBS)?". The formulation of the question for investigation was made using the PICO strategy,⁹ in which P (patient) indicates patients

diagnosed with IBS; I (intervention) refersto the diet with low content of FODMAPs; C (comparator) was not used as a form of non-discrimination; and O (outcome), the effect on gastrointestinal symptoms.

The articles were selected between December 2022 and January 2023, in the online databases PubMed, Lilacs, and Medline, through the portal Virtual Health Library (VHL), ScienceDirect, and Embase, combining English-language descriptors indexed in the Health Science Descriptors (Decs) system, Medical Subject Headings (MESH) and Embase’s own system (ENTREE), based on the PICOT search strategy, with addition of the study typology. The combinations of descriptors used and search strategy are presented in Table 1.

The inclusion criteria consisted of randomized controlled trials (RCTs) conducted in the past ten years (2013-2023) involving adult patients of any gender diagnosed with any subtype of IBS. The exclusion criteria encompassed studies that employed dietary interventions other than the low FODMAP diet (LFD), those involving patients diagnosed with intestinal disorders other than IBS, and studies that had objectives other than the evaluation of gastrointestinal symptoms.

Table 1. Search strategy of articles that were part of the systematic review.

SEARCH STRATEGY	
PATIENT	<i>"Irritable Bowel Syndrome" OR "irritable bowel syndromes" OR "Irritable Colon" OR "Mucous Colitis" OR "Mucous Colitides"</i>
INTERVENTION	<i>"FODMAP Diet" OR "FODMAP Diets" OR "FODMAPs Diet" OR "FODMAPs Diets" OR "FODMAP-Containing Diet" OR "FODMAP-Containing Diets" OR "Low FODMAP Diet" OR "Low FODMAP Diets" OR "Fermentable Oligo-Di-Monosaccharides" OR "fermentable oligosaccharides, disaccharides, monosaccharides, and polyols"</i>
CONTROL	-----
OUTCOME	<i>"Abdominal Pain" OR "Abdominal Pains" OR "Colicky Pain" OR "Colicky Pains" OR "Flatus" OR "Constipation" OR "Constipations" OR "Dyschezia" OR "Colonic Inertia" OR "Diarrhea" OR "Diarrheas" OR "abdominal bloating"</i>
STUDY TYPE	Randomized Controlled Trials
OPERATORS	OR e AND

The studies were initially selected by reading the titles. Then, duplicate articles and those that were not characterized as RCTs were excluded. After reading the abstracts and articles in full, those that met the objective of this review were maintained.

The evaluation of the studies included in this review was conducted by analyzing the risk of bias, using the Cochrane Risk of Bias tool with Review Manager (RevMan) (version 5.4, Cochrane Collaboration), based on the report of randomization, allocation, blinding, and results, studies were categorized as having "low risk," "high risk," or "uncertain risk" of bias.

RESULTS

Initially, 105 studies were identified in the online databases. After the first selection by title and removal of duplicates, 32 studies remained, from which 10 non-randomized studies were excluded, leaving 22 articles, which were read in full. In this stage, 11 articles that did not meet the inclusion and exclusion criteria were excluded, in addition to those that were not aligned with the objective of this study. Thus, 11 articles were selected to be part of this systematic review (Figure 1). The characteristics of the included studies are presented in Table 1.

Figure 1. Selection flow chart of studies that were part of the systematic review

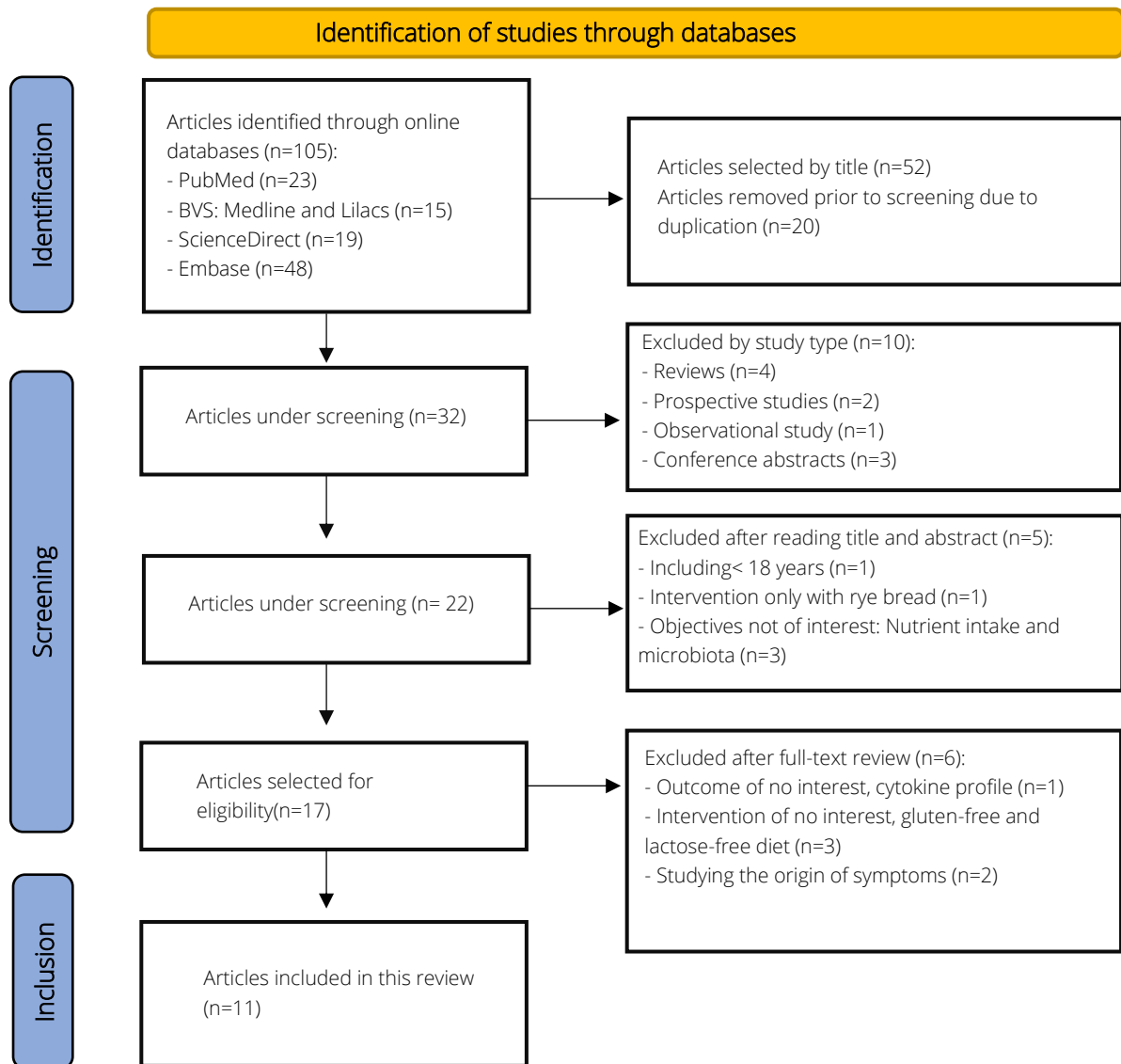


Table 1. Characteristics of the studies included in the review.

PUBLICATION	STUDY TYPE	DURATION	ASSESSMENT AND SUBTYPE	INTERVENTION	COMPARATOR	OUTCOME
ALGERA et al., 2022 Sweden - Europe	Double-blind, crossover RCT	4 weeks	ROMA IV IBS-C/ IBS-D/ IBS-M/ IBS-U	7 days LOW FODMAP n=16wash-out (-14 days)	7 days moderate FODMAPs n=15	A low FODMAP diet reduced overall gastrointestinal symptoms and affected bowel habits in IBS, but not compared to a diet containing moderate amounts of FODMAPs.
BÖHN et al., 2015 Sweden - Europe	Single-blind multicenter parallel RCT	4weeks	Roma III IBS-D/ IBS-C/ IBS-M/ IBS-U	Low FODMAPs diet n= 33	Traditional IBS diet mNICE n=34	The low FODMAP diet and traditional dietary counseling for IBS based on mNICE guidelines improved IBS symptoms, with no clear difference observed between the two strategies.
ESWARAN et al., 2016 USA- North America	Single-blind single-center RCT	4 weeks	Roma III IBS-D	Low FODMAPs dietn= 45	Diet, mNICE guidelines n=39	The low FODMAP diet resulted in significantly greater benefits for individual symptoms of IBS, particularly abdominal pain, bloating, stool consistency, and frequency, compared to the mNICE diet.
HALMOS et al., 2014 Australia - Oceania	Single-blind crossover RCT	3 weeks	Roma III IBS-D/ IBS-C/ IBS-M/ IBS-U	Poor FODMAPs dietn= 30	Typical Australian diet with moderate FODMAP intake n=24 8 healthy controls	Individuals with IBS had lower overall gastrointestinal symptom scores while following a low FODMAP diet compared to the Australian diet. Bloating and pain were reduced while patients with IBS were on the low FODMAP diet. Symptoms were minimal and unchanged on either diet among controls.
HARVIE et al., 2017 Australia - Oceania	RCT	6 months	Roma III IBS-D/ IBS-C/ IBS-M	Group I, low FODMAP diet at the beginning of the study and reintroduction of food sources at three months n=23 After 6 months n=16	Group II: Low FODMAP diet in the second three-month period. During the initial 3-month waiting period, they did not receive dietary education. n=27 After 6 months n=18	A low FODMAP diet improves symptoms of IBS, and this improvement can be maintained during the reintroduction of FODMAPs. Overall symptom reduction was sustained over six months in Group I and replicated in Group II during their intervention period, with reductions in pain severity, pain frequency, and abdominal distension.
MCINTOSH et al., 2017 Canada- North America	Prospective parallel single-blind RCT	3 weeks	Roma III IBS-D/ IBS-C/ IBS-M/ IBS-U	Low FODMAPs dietn=18	High FODMAP diet n=19	Overall gastrointestinal symptoms of IBS were reduced on the low FODMAP diet but increased during the high FODMAP diet.

Table 1. Characteristics of the studies included in the review.

PUBLICATION	STUDY TYPE	DURATION	ASSESSMENT AND SUBTYPE	INTERVENTION	COMPARATOR	OUTCOME
PATCHARATRAKUL et al., 2019 Thailand - Asia	Single-blind RCT	4 weeks	Roma III IBS C IBS-D	Individualized Structural Protocol for Low FODMAP Dietary Counseling n= 30	Brief advice on a commonly recommended diet protocol n=32	Low FODMAP dietary counseling was more effective than brief advice for patients with IBS, as it improved overall gastrointestinal symptoms of IBS to a greater extent.
RUSSO et al., 2022 Italy - Europe	Multidisciplinary single-blind parallel RCT	12 weeks	Roma IV IBS-D	Low FODMAPs diet n=21	Tritordeum-based diet n=21	Both diets equally improved gastrointestinal symptoms in patients with IBS-C.
STAUDACHER et al., 2017 United Kingdom - Europe	Multicenter 2x2 factorial RCT	4 weeks	Roma III IBS-D/ IBS-M/ SII-U	Low FODMAPs diet and placebo n=24 Low FODMAPs diet/probiotics n=27	False diet and placebo n=27 False diet and probiotics n=26	Low FODMAP dietary counseling led to improvements in overall and specific gastrointestinal symptoms in IBS compared to sham counseling, but there was no significant difference between those who received probiotic or placebo.
ZAHEDI; BEHROUZ; AZIMI, 2018 Iran - Asia	Single-blind RCT	6 weeks	Roma III IBS D	Low FODMAPs diet n = 50	Dietary recommendations from the British Dietetic Association n = 51	Both interventions led to significant improvement in gastrointestinal symptoms in patients with IBS-D. However, the low FODMAP diet provided greater benefits in alleviating IBS symptoms.
ZHANG et al., 2021 China - Asia	Single-center balanced RCT	3 weeks	Roma III IBS D	Low FODMAPs diet n = 51	Traditional dietary counseling based on mNICE guidelines n=49	Both interventions improved gastrointestinal symptoms in patients with IBS-D. The low FODMAP diet achieved greater symptom reduction and earlier than traditional dietary counseling.

RCT, Randomized Controlled Trial; IBS-C, Irritable Bowel Syndrome with Constipation Predominance; IBS-D, Irritable Bowel Syndrome with Diarrhea Predominance; IBS-M, Irritable Bowel Syndrome with Mixed Fecal Pattern; IBS-U, Unclassified Irritable Bowel Syndrome; FODMAP, Fermentable Oligo-, Di-, Mono-saccharides and Polyols; Wash-out, Treatment-free period; mNICE, Modified NICE Diet recommended by the National Institute for Health and Care Excellence; IBS-SSS, Irritable Bowel Syndrome Severity Scoring System

Numerous studies show that LFD reduces the symptoms of IBS.¹⁰ All reviewed studies applied dietary counseling as a way to reduce the intake of FODMAPs in patients of both sexes but with a predominance of females. The LFD was effective in reducing the symptoms of IBS, on a larger or equal scale, compared to the control groups. However, methods to assess intestinal and extra-intestinal symptoms varied between studies, with the majority using the IBS-Severity Scoring System (IBS-SSS), except one that used a standard question¹¹ and two studies that employed the Visual Analog Scale.^{12,13}

The study by Algera et al.¹⁴ revealed that LFD significantly reduced the overall IBS-SSS score, from 308±79 to 244±111. In comparison, the group treated with a moderate FODMAP diet exhibited less significant change, with scores decreasing from 317±84 to 307±111. Patients treated with LFD presented lower abdominal pain, and the frequency of pain decreased from 66±24 to 46±30. For those treated with a moderate diet in FODMAPs, the frequency of pain ranged from 63±26 to 63±31 before and after, respectively. There was improvement in intestinal habits, according to the Bristol Scale, especially in patients with diarrheal pattern (SII-D). Intestinal improvement in the presence of LFD was lower in patients with constipation patterns (SII-C).

The IBS-SSS assesses the severity of IBS symptoms, covering the frequency and intensity of abdominal pain, abdominal distension, dissatisfaction with bowel habit, and interference in daily life. The total score ranges from 0 to 500, with moderate severity defined as scores between 175 and 300. Scores below 175 indicate mild severity, while scores above 300 indicate severe severity. Studies consider a change of more than 50 points as clinically significant.¹⁴

Halmos et al.¹² observed that before the interventions, patients with IBS had a mean score of 36.0mm on the Visual Analogue Scale (VAS). After 14 days of LFD, the average score decreased to 22.8mm. On the other hand, patients on an Australian diet, moderate in FODMAPs, had a high average score of 44.9mm in the VAS. Healthy individuals did not show significant changes in symptoms during both interventions. LFD improved dissatisfaction with stool consistency in all IBS subtypes, while this dissatisfaction remained unchanged with a moderate diet in FODMAPs.

VAS scores individuals from 0 to 100 mm, reflecting the absence of symptoms and the most severe ones. In the studies, differences of 10mm or more are considered clinically significant.¹²

In the study by McIntosh et al.¹⁵ patients undergoing LFD reduced the overall IBS-SSS score by 28%, with an isolated 52% reduction in abdominal pain intensity. Patients submitted to a diet rich in FODMAPs had an average increase of 7% in general symptoms, and 34% in pain intensity.

Böhn et al.,¹⁶ Eswaran et al.,¹¹ and Zhang et al.¹⁷ compared LFD with the mNICE diet, based on the recommendations of the National Institute for Health and Care Excellence (NICE) for IBS. The mNICE diet promoted regular eating habits such as scheduled meals, thorough chewing, and avoidance of fatty, spicy foods, coffee, and alcohol, without specifically eliminating foods high in FODMAPs. The main focus was "how" and "when" to eat, not worrying about the type of food.

Böhon et al.¹⁶ did not observe a significant difference in the overall IBS-SSS score between the groups studied. The LFD group initially scored 324±69, decreasing to 246±127, while the mNICE diet group started with 302±61, reducing to 236±78 ($p < 0.001$). Regarding the IBS subtype, 70% of patients with IBS-D responded favorably to LFD, compared to 44% of patients with IBS with constipation, but without statistical significance ($p=0.34$). There was no significant difference in reducing the severity of general symptoms between the subtypes through the IBS-SSS ($p=0.76$).

Eswaran et al.¹¹ assessed symptoms in patients with IBS-D using an 11-point scale question: "In the past seven days, compared to before starting the diet, have you experienced sufficient relief from all your IBS symptoms?". Symptom relief was observed in 52 and 41% of patients who consumed LFD or mNICE, respectively. In the end, LFD promoted a greater reduction in symptoms compared to baseline: abdominal pain decreased from 5.22 ± 1.5 to 3.38 ± 2.0 , and swelling decreased from 4.84 ± 1.8 to 3.11 ± 1.8 . In mNICE, scores decreased from 5.01 ± 1.3 to 4.41 ± 2.2 for abdominal pain and from 5.02 ± 2.1 to 4.54 ± 2.5 for swelling.

Zhang et al.¹⁷ observed a greater reduction in symptoms in patients with IBS-D when in LFD, compared to mNICE. In this study, the primary endpoint (reduction greater than or equal to 50 points in the IBS-SSS of the general symptoms of IBS) was reached in 55.6% of the patients in the low FODMAPS group, who also presented a lower number of defecations. Of the mNICE group, 48.1% reached the primary endpoint.

In the study by Harvie et al.,¹⁸ patients with IBS of all subtypes were treated with LFD over six months, divided into two groups: (GI) application of LFD in the beginning and maintained for three months, with reintroduction of FODMAPs in the last three months; and (GII) LFD only in the last three months, without dietary guidance in the first three months. In the GI, at three months, there was a reduction of 144.5 ± 89.0 points in the overall IBS-SSS score while in the GII, the reduction was 38.7 ± 74.8 .

In the first three months, GI patients presented a greater reduction in bowel movements and frequency of pain, compared to GII. The reduction in pain frequency was maintained for up to six months in GI, even with the reintroduction of FODMAPs, and was replicated in GII between three and six months. In the intervention period for the GII, there was a significant reduction in the IBS-SSS score for pain severity, from 33 ± 26 to 17 ± 17 ; in pain frequency, from 3.3 ± 2.5 to 1.9 ± 2.1 ; and in abdominal distension, from 39 ± 36 to 17 ± 20 .

Patcharatrakul et al.¹³ evaluated patients with IBS-C and non-constipation, submitted to LFD and to brief advice on how to avoid gas-triggering foods, bloating or abdominal pain (fruits, vegetables, nuts, beans, and garlic), and avoid large meals. Sixty percent of patients submitted to LFD and 28% to brief advice had an average reduction of 30% or more in abdominal pain and discomfort after four weeks. The overall severity score of IBS symptoms, assessed by VAS, decreased significantly with LFD, from 61.2 ± 21.0 to 38.5 ± 20.0 at the end of the study. In the brief councils, there was no significant change, scoring 56.3 ± 17.8 and 53.5 ± 19.2 at the end.

Russo et al.¹⁹ offered a diet based on Tritordeum (TBD), a hybrid cereal of durum wheat and barley, with lower levels of gliadins, carbohydrates, and fructans, and higher content of dietary fiber, protein, and antioxidants to patients with IBS-D compared to LFD. During TBD, patients consumed flour, bread, morning biscuits, and pasta prepared exclusively with cereal. Both diets resulted in a reduction of general symptoms of IBS, according to IBS-SSS, with no significant difference in total reduction of symptoms. The LFD scored 259.9 points at baseline (week 1) and 127.8 at week 12. TBD scored 286 at baseline and 155.4 at the end of the study. The greatest discrepancy in symptoms occurred in the frequency of abdominal pain, with a reduction of 26.7 points for LFD and 23.7 points for TBD.

In the study by Staudacher et al.,²⁰ patients with IBS showed a greater decrease in symptoms with LFD, compared to the simulated diet, according to the IBS-SSS. The final score in IBS-SSS was 173 ± 95 for LFD, compared to 224 ± 89 of the simulated diet, and there was no significant difference

between those who received probiotics (207 ± 98) or placebo (192 ± 93), with $p = 0.721$. In isolation, patients treated with LFD obtained lower scores in the IBS-SSS when compared to the simulated diet for all items, with greater emphasis on pain severity, distension, and pain days.

Zahedi, Behrouz & Azimi²¹ used general dietary advice (GDA), based on the recommendations of the British Dietetic Association, to treat IBS-D. Patients were recommended to limit caffeine, alcohol, spiced foods, fatty, carbonated drinks, and guidance on other eating habits. The IBS-SSS results showed more significant relief in symptoms in the low FODMAP group, compared to GDA. The average initial score for the low FODMAP group was 263.75 ± 91.25 , decreasing to 108 ± 63.82 . In the GDA there was a reduction in the average score, from 252.5 ± 85.51 to 149.75 ± 51.39 . Individually, the improvement in dissatisfaction with intestinal transit was more pronounced in the low FODMAP group, reducing 38 ± 5.66 points, compared to GDA, which reduced 23.13 ± 5.13 points at the end of the study.

For most of the studies reviewed, patients reduced caloric intake and fiber consumption when treated with LFD.^{11,12,16-18,21} Unlike the others, Harvie et al.,¹⁸ after applying the reintroduction of FODMAPs, observed a return to normal energy and fiber levels.

In addition to analyzing the role of FODMAPs in gastrointestinal symptoms of IBS, some authors used the Irritable Bowel Syndrome Quality of Life Instrument (IBS QoL) questionnaire to assess the quality of life in IBS.^{18,20,21} Dysphoria subscales, interference with daily activity, body image, health concern, avoidance of food, social reaction, and sexual relations were evaluated, with a total score ranging from 0 (worst quality) to 100 (better quality of life).

Harvie et al.¹⁸ found a significant improvement in patients' quality of life after three months of LFD, extending over six months, including during the reintroduction of FODMAPs in the GI and replicated in the GII when receiving the same intervention. Food avoidance was the only subscale that did not show improvement in GI. In GII, during the intervention, the concern with health and food avoidance did not improve. Zahedi, Behrouz, and Azimi²¹ did not observe significant differences in the IBS-QoL score between the groups studied, indicating that both interventions contributed to the improvement of quality of life. Staudacher et al.,²⁰ using IBS-QoL, observed improved body image and social reaction, indicating a better quality of life with LFD.

Using 16S rRNA sequencing, a technique to evaluate the sequencing of the human microbiome, a reduction of the species *Bifidobacterium* was observed in patients with IBS when treated with LFD.^{15,17,20}

The analysis of the methodological quality of the studies in this review showed that the majority presented some risk of bias (Table 2), with a higher predominance for concealment of unclear allocation and a high risk of bias in blinding participants, personnel, and evaluation of results.

Table 2. Risk of Bias

Publication	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
ALGERA et al., 2022	LOW	LOW	LOW	LOW	LOW	LOW	LOW
BÖHN et al., 2015	LOW	UNCERTAIN	HIGH	UNCERTAIN	LOW	LOW	LOW
ESWARAN et al., 2016	LOW	LOW	HIGH	UNCERTAIN	LOW	LOW	LOW
HALMOS et al., 2014	LOW	UNCERTAIN	HIGH	UNCERTAIN	LOW	LOW	LOW
HARVIE et al., 2017	LOW	UNCERTAIN	HIGH	HIGH	LOW	LOW	LOW
MCINTOSH et al., 2017	LOW	LOW	HIGH	UNCERTAIN	LOW	LOW	LOW
PATCHARATRAKUL et al., 2019	LOW	UNCERTAIN	LOW	UNCERTAIN	LOW	LOW	LOW
RUSSO et al., 2022	LOW	LOW	HIGH	UNCERTAIN	LOW	LOW	LOW
STAUDACHER et al., 2017	LOW	LOW	LOW	LOW	LOW	LOW	LOW
ZAHEDI; BEHROUZ; AZIMI, 2018	LOW	UNCERTAIN	UNCERTAIN	HIGH	LOW	LOW	LOW
ZHANG et al., 2021	LOW	LOW	LOW	LOW	LOW	LOW	LOW

Source: prepared by the authors.

DISCUSSION

Dietary intervention is the recommended initial treatment for functional gastrointestinal disorders, including IBS, especially when combined with lifestyle adjustments.¹⁰ However, it is crucial to provide appropriate guidance and education to patients to reduce symptoms and avoid risks of nutritional deficiencies.³

LFD was developed in 2004 by researchers at the University of Monash in Australia, introducing the term FODMAP.²² The basis of the diet is that poorly digested and unabsorbed carbohydrates in the small intestine are quickly fermented by intestinal bacteria, resulting in symptoms such as bloating, abdominal pain, excessive flatulence, and changes in bowel habits.^{1,23}

FODMAPs are not fully absorbed in the small intestine due to inhibition or transport failures through the epithelium, enzyme deficiencies in digestion, and molecular size that prevents simple diffusion absorption. Thus, the presence and intensity of symptoms vary according to the degree of malabsorption experienced by each individual.^{24,25}

The implementation of LFD involves three steps: initial restriction of foods rich in FODMAPs for four to six weeks, followed by gradual and isolated reintroduction of these excluded foods for six to eight weeks to assess individual tolerance, and finally, the maintenance of the diet with the consumption of the subgroups of FODMAPs tolerated in the long term.^{1,26}

The studies included in this systematic review indicate that the low FODMAP diet (LFD), compared to habitual or high FODMAP diets, effectively alleviates overall gastrointestinal symptoms in adult patients with IBS. It notably reduces the frequency and severity of abdominal pain and bloating, thus serving as a crucial treatment option when implemented under the guidance of a qualified dietitian to prevent nutritional deficiencies, particularly in terms of energy and fiber intake.

The reviewed studies compared LFD with other diets, including habitual, standard, guideline-based, and other treatments. Although other diets, such as those based on mNICE, have contributed to relieving symptoms of IBS, LFD showed better results when analyzing individual symptoms.^{11,17,18} A study of 82 patients with IBS had already shown significant improvements in abdominal distension, abdominal pain, and flatulence for those treated with LFD compared to mNICE. In this study, 76 and 54% of patients reported improvement of symptoms, with LFD and mNICE, respectively.²⁷

Russo et al.¹⁹ confirmed that LFD is more effective for the treatment of patients with IBS. However, TBD may be a viable alternative, especially for Italian patients, due to the importance of mass in food culture. However, further studies on this intervention are needed, as it was developed only for patients with IBS-D and applied to a single population.

Some studies indicate moderate improvement in the production and frequency of feces in patients with IBS after LFD, based on the Bristol scale.^{12-14,16} For Algera et al.,¹⁴ LFD may be more effective for patients with IBS with softened stools, compared to those with hard and less frequent stools. On the other hand, there was a significant improvement in bloating and abdominal pain with LFD in all subtypes of IBS, as already observed by Altobelli et al.²⁸ As this effect was observed in both diarrhea-predominant and constipation-predominant patients, it indicates that FODMAPs' impact goes beyond mere osmotic effects.¹⁵

A previously negative point demonstrated by the reviewed RCTs is that, with LFD, patients tend to reduce caloric intake. This may have occurred, although patients have not been advised to reduce caloric intake, because detailed dietary advice that limits the intake of certain foods can result in this unwanted effect. In the short term, this should not pose harm, thus the diet should not be utilized for an extended duration during the exclusion phase.¹⁶ In addition, a reduction in fiber intake was also observed.

The reduction in the content of FODMAPs can decrease fiber intake, especially when wheat, fruit, and vegetable products rich in FODMAPs are not replaced by suitable alternatives. Therefore, nutritional monitoring is crucial to ensure adequate fiber intake through food replacement.^{29,30} In addition, after the LFD exclusion period, the reintroduction of tolerated FODMAPs, such as FOS and GOS, may increase fiber ingestion¹⁸ and, consequently, soften the stool in patients with subtype SII-C.³¹

In the intestinal microbiota, a reduction in the Bifidobacterium population was observed after LFD.^{15,17,20} Similar findings were also noted in other studies.³²⁻³⁴ Staudacher et al.,²⁰ in their study - unique among those

reviewed here for implementing the low FODMAP diet alongside probiotic supplementation containing strains of bifidobacteria - observed a greater abundance of bifidobacteria.

The restriction of short-chain fermentable carbohydrates may be effective in the management of IBS but may affect the intestinal microbiota. Carbohydrates such as FOS and GOS have prebiotic effects, promoting the growth of *Bifidobacterium* and *Faecalibacteriumprausnitzii*, with immunomodulatory properties and butyrate production.³² This impact was observed by Staudacher et al.,³⁵ who, when analyzing the reintroduction period, unlike the studies of this review, concluded that, in the long term, the consumption of foods rich in FOS and GOS reintroduced restores the abundance of *Bifidobacterium*, due to the prebiotic effect of oligosaccharide fibers.

Patients treated with LFD reported improvement in quality of life.³⁶ IBS negatively impacts the quality of life, resulting in more absences at work, frequent medical visits, greater use of medicines, need for rest, and less social interaction.³⁷⁻³⁹ In addition, patients often face difficulties in performing daily activities and suffer psychologically.⁴⁰ Therefore, the improvement in the quality of life provided by LFD can contribute to a lifestyle closer to that of healthy people.

It is important to highlight that restrictive diets can be stressful for patients with both intestinal diseases and IBS. Any attempt to eliminate more foods or impose additional restrictions on the diet can hinder adherence, produce opposite results, and hurt the quality of life of patients with IBS.⁴¹ This addresses the issue of avoiding foods that did not result in improvements in IBS-QoL during studies that implemented the low FODMAP diet.

With the exception of Harvie et al.,¹⁸ the reviewed studies did not assess the long-term effects of the low FODMAP diet, including the reintroduction phase to identify tolerated FODMAPs and the maintenance of the diet. Based on this, future studies are necessary to obtain definitive answers about the potential effect on long-term nutritional adequacy and also on the intestinal microbiota during LFD.

In addition, there were no RCTs addressing LFD applied to patients with IBS in the Brazilian scenario. Therefore, given that the dietary foundation of the low FODMAP diet originates from Australia and is rooted in different dietary, nutritional, and cultural norms, it is crucial to conduct high-quality studies that incorporate FODMAPs into the dietary habits of the Brazilian population.

CONCLUSION

This systematic review concluded that low-FODMAPs diet (LFD) is an important therapeutic approach to irritable bowel syndrome (IBS), effectively reducing gastrointestinal symptoms in diagnosed adults. However, further research is needed to understand the long-term effects of LFD on quality of life, nutritional adequacy, and gut microbiota.

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Contributors

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