

STRUŻEK, Konrad, KARAMUS, Kornelia, REJMAK, Rafał, BIŁOGRAS, Jan, BOROWSKA-LYGAN, Martyna, URBAN, Wojciech and TOMASZEWSKI, Jakub. Low-FODMAP Diet in the Treatment of Irritable Bowel Syndrome – Efficacy, Comparison with Other Diets, Mechanisms, and Clinical Applications. *Journal of Education, Health and Sport*. 2025;80:59059. eISSN 2391-8306.  
<https://doi.org/10.12775/JEHS.2025.80.59059>  
<https://apcz.umk.pl/JEHS/article/view/59059>

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).

Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2025;

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 26.02.2025. Revised: 02.03.2025. Accepted: 04.04.2025. Published: 06.04.2025.

## **Low-FODMAP Diet in the Treatment of Irritable Bowel Syndrome – Efficacy, Comparison with Other Diets, Mechanisms, and Clinical Applications**

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## Abstract

Irritable bowel syndrome (IBS) is a common functional gastrointestinal disorder that significantly impacts patients' quality of life. One of the most frequently used and well-documented dietary approaches in the treatment of IBS is the low-FODMAP diet, which involves the elimination of fermentable oligosaccharides, disaccharides, monosaccharides, and polyols that can exacerbate gastrointestinal symptoms.

This article presents the mechanisms of action of the FODMAP diet, its effectiveness, and a comparison with other dietary approaches used in IBS, such as the gluten-free and Mediterranean diets. The three-phase model of the diet, including the elimination, reintroduction, and personalization phases, is discussed, enabling dietary adaptation to individual patient tolerance. A review of studies has shown that the effectiveness of the FODMAP diet in reducing IBS symptoms ranges from 50% to 75%, making it one of the most effective dietary strategies for managing this condition.

Additionally, potential biomarkers for dietary response, such as breath tests, gut microbiota analysis, and fecal and urinary metabolites, are explored to help identify patients who may benefit most from this approach. The article also emphasizes the importance of a multidisciplinary approach in IBS treatment, integrating dietary therapy, gastroenterological support, and psychological interventions.

Despite the high efficacy of the FODMAP diet, its long-term consequences, particularly its impact on gut microbiota and metabolism, require further research. The article highlights the need for continued analysis of the diet's lasting effects and its effectiveness in different IBS subtypes, which could contribute to even better personalization of therapeutic strategies to meet patients' individual needs.

## Keywords:

Irritable bowel syndrome (IBS), low-FODMAP diet, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP), dietary treatment of IBS, gut microbiota, breath tests, dietary response biomarkers, diet personalization, nutritional therapy in IBS, FODMAP diet efficacy, multidisciplinary approach in IBS treatment.

## 1. Introduction

### 1.1 Definition and Epidemiology of IBS

Irritable Bowel Syndrome (IBS) is a gastrointestinal disorder characterized by changes in bowel habits, accompanied by discomfort or abdominal pain, in the absence of visible structural or biochemical abnormalities [1]. Approximately 12% of patients seek primary healthcare due to IBS-related symptoms [2,3]. Studies indicate that the prevalence of IBS ranges from 10% to 15%; however, most individuals affected by this condition do not seek medical assistance [2].

IBS is most frequently diagnosed in South America, where its prevalence is estimated at around 21%, whereas it is least common in Southeast Asia, with a prevalence rate of 7% [4,5]. In the United States, Canada, and Israel, IBS symptoms are 1.5 to 2 times more prevalent in women than in men [6]. Moreover, women are more likely to report abdominal pain and constipation, whereas men more frequently experience diarrhea [6].

### 1.2 Role of Diet in IBS

Over 80% of individuals with IBS recognize a connection between their symptoms and food intake, leading them to modify their diet in an attempt to alleviate discomfort. Instead of using medications, many patients opt for elimination diets, such as a gluten-free diet (GFD) or diets based on IgG antibody testing. However, the effectiveness of these methods is not supported by strong scientific evidence [7,8,9,10,11,12].

Among the available dietary approaches, the low-FODMAP diet (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) is currently the most well-documented intervention for IBS management. FODMAP components are found in varying concentrations in selected fruits, vegetables, legumes, dairy products, artificial sweeteners, and nuts [13].

## 2. Low-FODMAP Diet

The modern low-FODMAP diet includes six types of carbohydrates and is designed to reduce the intake of all FODMAP groups by selecting alternative low-FODMAP products. Published food composition tables provide detailed information on different food items, assisting individuals in making informed dietary choices [14].

Additional strategies for reducing FODMAP intake include adding lactase to foods or taking it orally to lower lactose levels in relevant food products. It is also recommended to combine glucose with foods rich in free fructose, which may improve their tolerance in individuals with IBS [15].

FODMAPs share three common functional properties:

1. Their absorption in the small intestine is limited.
2. They are small molecules with osmotic activity.
3. They undergo rapid fermentation by gut bacteria.

## 2. Treatment Phases

The effectiveness of the low-FODMAP diet is greater when implemented by a multidisciplinary team of specialists, including a dietitian, a gastroenterologist, and a mental health specialist with appropriate training. In many cases, symptoms subside within two weeks. However, if there is no improvement after three to four weeks, the patient should discontinue the diet.

The diet consists of three phases. In pediatric studies [16], Phase 1 lasts 2–3 weeks, Phase 2 can extend up to 8 weeks, and Phase 3 has a variable duration depending on individual tolerance and needs.

Figure 1 summarizes the phases of the diet, which typically lasts 2–3 months for most patients.

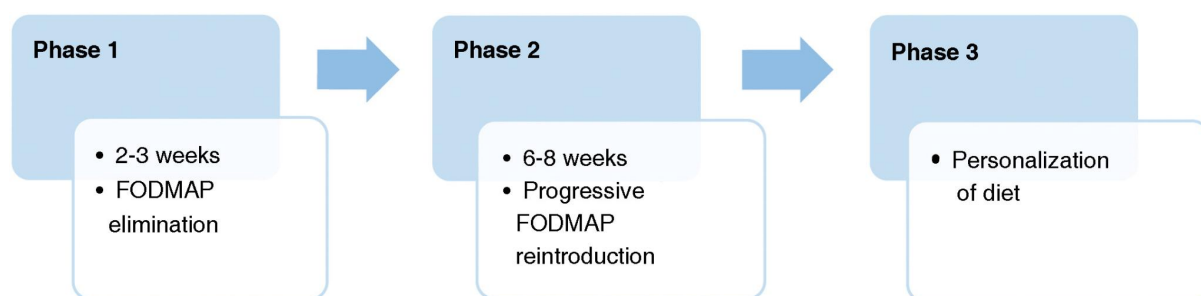


FIG. 1. Graph of the Phases of the Low-FODMAP Diet. Source: Adapted from Grez et al. [17]

### 2.1. First Phase: Elimination of Foods Containing FODMAPs

High-FODMAP foods are eliminated for a period of 2–3 weeks, during which changes in symptoms are monitored. If symptoms do not improve, it is necessary to assess both the diet being followed and the patient's adherence to it.

In the pediatric population, a two-week FODMAP elimination phase may be as effective as a three-week phase in adults while minimizing potential risks and making adherence easier. Studies indicate that most patients find the diet easy to follow, leading to high compliance and better symptom control. Patients typically experience improvement within two weeks. [18]

### 2.2. Second Phase: Reintroduction of Foods Containing FODMAPs

Before beginning the second phase, the effectiveness of the previous stage in alleviating symptoms is evaluated. If it has been successful, high-FODMAP foods are gradually reintroduced according to a structured schedule. The goal of this process is to determine which foods trigger symptoms and which are well tolerated. The order of reintroducing different FODMAP groups in children is the same as in adults.

Each week, a specific FODMAP is introduced, which the patient consumes for three days. For each type of FODMAP, the patient selects one of two available food products containing the given ingredient. The amount consumed is gradually increased, allowing an assessment of

the body's tolerance and identification of potential symptom triggers. (19) During these days, the patient should keep a food and symptom diary, recording the foods eaten, their amounts as recommended, and any symptoms that occur during or after consumption. Regular monitoring enables patients, along with their parents or caregivers, to identify specific FODMAP components that cause discomfort and determine the threshold dose at which symptoms appear. (20)

After three days of reintroducing a particular FODMAP, tolerated foods are maintained in the diet at an acceptable dose for the next four days of the week. During this period, the patient continues to follow the previously recommended low-FODMAP diet. This process allows for a gradual assessment of the body's response and the effective identification of foods that can be safely consumed without triggering symptoms.

For patients who experience symptoms within the three-day reintroduction period, the dose should not be increased, nor should the food continue to be consumed. After a break of 4 to 7 days, allowing symptoms to subside, the next FODMAP group can be introduced.

An alternative approach is to continue reintroducing the same food the next day but at half the dose or replace it with another food containing the same type of FODMAP. However, if symptoms recur despite the dose reduction, this suggests an intolerance to the entire FODMAP group. In such cases, patients are advised to avoid these foods whenever possible. [18,20]

Once individual FODMAP tolerance levels are determined, the diet is adjusted to minimize restrictions as much as possible. The goal of this approach is to reduce potential negative effects on gut microbiota, colonocyte metabolism, and the patient's long-term nutritional status. This way, the dietary plan becomes more balanced, allowing for the broadest possible range of foods while avoiding those that trigger symptoms. [21] During follow-up, regular anthropometric measurements are recommended, as patients often experience weight loss during this phase of treatment. Monitoring body weight and other physical parameters enables the early detection of potential nutritional deficiencies and allows for dietary adjustments to ensure the patient's proper nutritional status. [22,17]

### 2.3. Third Phase: Personalization

This phase focuses on implementing a long-term, individualized dietary plan tailored to the patient's needs, tolerance, culture, and preferences. At this stage, the diet becomes more varied and less restrictive, eliminating only those FODMAPs that trigger symptoms. As a result, the patient can consume the broadest possible range of foods while minimizing the risk of symptom recurrence.

If symptoms do not improve, other possible causes of discomfort should be considered. During this phase, it is important for the patient to remain under regular specialist supervision; however, maintaining a food and symptom diary is no longer necessary. [20] Ongoing monitoring allows for dietary adjustments and further modifications if needed to ensure optimal well-being and symptom control.

### 3. Markers of Response to the FODMAP Diet

Most studies have focused on analyzing the effectiveness of the low-FODMAP diet among individuals with irritable bowel syndrome (IBS), demonstrating an efficacy rate of 50–75%, as previously mentioned. Efforts have also been made to enhance the effectiveness of this approach and identify potential prognostic factors for response to therapy, including distinguishing subgroups of IBS patients for whom the diet is particularly beneficial.

In a recent crossover study, it was found that patients who experienced clinical improvement tended to have a more severe form of IBS (as assessed by the IBS Severity Scoring System, IBS-SSS) and higher levels of anxiety at the beginning of the study. However, further research is needed to confirm this finding.

### 3.1. Breath Test

In a recent limited pilot study, a positive result in the FODMAP meal challenge breath test—defined as hydrogen (H<sub>2</sub>) levels in the breath exceeding the baseline by more than 10 PPM, along with the occurrence of symptoms after consuming a high-FODMAP meal—demonstrated a sensitivity, specificity, and diagnostic accuracy of 78.6%, 66.6%, and 75.6%, respectively, in predicting the effectiveness of the low-FODMAP diet.

### 3.2. Microbiota Analysis

Potential prognostic factors for the effectiveness of the low-FODMAP diet include gut microbiota composition and the diversity of specific bacterial strains.

In 2015, Chumpitazi et al. conducted a double-blind, crossover study involving children with IBS, randomly assigned to either a low-FODMAP diet or a standard American pediatric diet. Patients who responded positively to the low-FODMAP diet initially exhibited an increased presence of taxa with a higher metabolic capacity for carbohydrate breakdown, including bacteria from the Bacteroidaceae family (e.g., *Bacteroides*), the Clostridiales order (e.g., Ruminococcaceae, *Dorea*, and *Faecalibacterium prausnitzii*), and the Erysipelotrichaceae family.

Several studies have highlighted the significant role of increased methane production in the colon and short-chain fatty acids (SCFA) in conjunction with heightened saccharolytic fermentation activity. These findings emphasize the critical importance of the gut microenvironment in modulating responses to dietary interventions.

Vervier et al. identified two distinct microbiota subtypes in IBS patients, with the "pathogen-like" subtype—characterized by an increased presence of Firmicutes and a lower abundance of Bacteroidetes—showing a stronger response to the low-FODMAP diet. The microbiome of IBS patients following this diet has also been assessed using a commercial "dysbiosis test" analyzing bacterial DNA profiles. Valeur et al. observed higher initial levels of Actinobacteria and *Streptococcus* in diet responders, while Bennett et al. reported lower baseline levels of these microorganisms among responders.

These conflicting findings regarding the role of specific microbial species in predicting responses to the low-FODMAP diet highlight the need for further research. Such discrepancies may stem from high methodological heterogeneity, including variations in

microbiome analysis techniques, study design, population characteristics (e.g., different IBS subtypes classified according to Rome criteria), and methods for assessing the diet's effectiveness.

### 3.3. Fecal and Urinary Metabolites

Volatile organic compounds (VOCs) act as mediators or end products in metabolic pathways, providing valuable insights into various aspects of colonic metabolism. Although significant differences in fecal VOC profiles have been observed between responders and non-responders to the low-FODMAP diet, the identification of specific metabolites that can predict dietary response remains an ongoing area of research. Specific fecal VOC profiles have demonstrated considerable accuracy in predicting responses to the low-FODMAP diet.

While a Swedish study successfully predicted responses to the low-FODMAP diet based on fecal bacterial profiles, a recent UK-based study failed to replicate these findings. This highlights the uncertainty in the field and underscores the need for further research into the effects of the low-FODMAP diet on the gut microbiome.

A recent blinded randomized controlled trial (RCT) conducted by Wilson et al. included IBS patients following either a sham diet or a low-FODMAP diet. The results showed that baseline fecal metabolites—such as higher concentrations of **fecal propionate esters and cyclohexanecarboxylic acid**—as well as urinary metabolites, helped differentiate patients who responded to the low-FODMAP diet. These findings align with previous observations.

In contrast to earlier studies suggesting that fecal microbiota composition could serve as a predictor of response to the low-FODMAP diet, this study did not establish such a correlation. However, it is worth noting that the sample sizes used in the comparisons were relatively small, which may have influenced the results. Further large-scale studies are necessary to validate these findings.

## 4. Effectiveness Compared to Other Diets and Treatment Methods for IBS

A recent network meta-analysis compared the effectiveness of various diets in managing IBS, including the low-FODMAP diet, BDA/NICE dietary guidance, and alternative nutritional approaches, assessing their impact on global and individual IBS symptoms.

The results showed that the low-FODMAP diet was the most effective in alleviating overall IBS symptoms. Additionally, it proved to be more effective in reducing bloating and abdominal distension compared to NICE and BDA dietary recommendations. It also demonstrated greater improvement in abdominal pain compared to a placebo diet.

However, regarding bowel habits (e.g., stool frequency and consistency), no significant differences were observed between the low-FODMAP diet and other dietary approaches. [23]

A randomized controlled trial (RCT) compared the effectiveness of the low-FODMAP diet with traditional dietary advice based on NICE guidelines in a group of 100 patients with IBS-D (diarrhea-predominant irritable bowel syndrome).

The evaluated parameters included the IBS-Symptom Severity Score (IBS-SSS) and IBS-Related Quality of Life (QOL), which helped determine the impact of both dietary strategies

on patients' conditions. Both groups experienced improvements, but the low-FODMAP diet provided greater benefits.

Specifically, a reduction of more than 50 points in IBS-SSS was achieved by 62.7% of patients following the low-FODMAP diet, compared to 40.8% of those adhering to traditional dietary recommendations. These results suggest that the low-FODMAP diet may be a more effective approach to managing IBS-D symptoms than standard dietary guidance. [24,25]

An RCT conducted by Halmos and colleagues evaluated the impact of the low-FODMAP diet compared to a traditional Australian diet in patients with IBS. The results showed that the low-FODMAP diet was more effective in reducing overall gastrointestinal symptoms.

Notably, significant improvements were observed in reducing bloating and abdominal pain, confirming its superiority over a standard diet. This study provides further evidence supporting the effectiveness of the low-FODMAP diet in alleviating IBS symptoms and its potential role as the preferred dietary strategy for patients suffering from this condition. [26]

In a small crossover RCT conducted by Paduano and colleagues, 42 patients with different IBS subtypes were randomly assigned to one of three dietary groups: the low-FODMAP diet (LFD), a gluten-free diet (GFD), and the Mediterranean diet (MD), which was used as an example of a "balanced diet."

The results showed that all three diets contributed to a reduction in gastrointestinal symptoms, as assessed by a visual analog scale (VAS), and improved patients' quality of life. However, the authors emphasized that further research with a larger patient cohort is needed to confirm these findings.

Additionally, the study found that the low-FODMAP diet had a positive impact on gut transit, as reflected in improved Bristol Stool Chart scores. It was the only diet that allowed IBS-D patients to reach the fourth level of the scale, which is considered the optimal stool consistency.

These findings suggest that the low-FODMAP diet may be particularly effective in regulating bowel function in IBS-D patients, but they require confirmation in studies with a larger patient sample. [27]

Menees et al. compared the effects of the low-FODMAP diet and psyllium treatment. The authors found that a four-week intervention with the low-FODMAP diet was associated with a significant improvement in mean Fecal Incontinence Severity Index (FISI) scores for stool consistency compared to baseline (39.2 vs. 32.6,  $p = 0.02$ ), whereas psyllium did not show a similar effect (35.2 vs. 32.5,  $p = 0.22$ ). [28]

## 5. Conclusions

The low-FODMAP diet has emerged as an effective strategy for alleviating the symptoms of irritable bowel syndrome (IBS), providing relief for those affected by the condition. Current best practices in managing IBS recommend a care model that integrates medical treatment, dietary modifications, and psychological therapy.

This comprehensive approach, implemented by a multidisciplinary team of specialists (gastroenterologists, dietitians, and therapists), aims not only to improve patients' quality of life but also to enable them to independently and effectively manage their symptoms over the long term.



The effectiveness, adaptability, and flexibility of the low-FODMAP diet make it a promising option for individuals seeking relief from IBS-related discomfort. However, most studies have focused primarily on patients with IBS-D (diarrhea-predominant IBS), indicating that gaps in knowledge remain—particularly regarding the diet’s impact on the gut microbiome and its long-term consequences, especially in the second and third phases.

Over the past two decades, research on IBS has evolved in parallel with its definition, contributing to a better understanding of the condition. Although data on the long-term effectiveness and adherence to the diet are still lacking, preliminary findings from observational studies are promising, suggesting that it may offer a sustainable and effective solution for managing IBS symptoms.

The implementation of the low-FODMAP diet should occur under the supervision of a qualified healthcare professional to ensure that it is properly balanced and nutritionally adequate. Professional dietary support is crucial to avoid nutritional deficiencies and to tailor the diet to the patient’s individual needs.

Despite these encouraging results, further research is needed to better understand the long-term consequences and benefits of the FODMAP diet in managing IBS. Future studies should particularly focus on the diet’s impact on the gut microbiome, the durability of its effects, and its effectiveness across various IBS subtypes. [29]

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