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The role of the low-FODMAP diet in the treatment of Irritable Bowel Syndrome - A Literature Review

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Abstract

Background and Aims: Irritable bowel syndrome (IBS) is a common GI disorder that responds to dietary interventions, such as the low-FODMAP diet [1], and this review provides an overview of current evidence for its clinical efficacy and microbial impact.

Methods and Results: A growing body of data from systematic reviews and meta-analyses demonstrates that a low-FODMAP diet is highly effective in reducing overall GI symptoms in adults with IBS [2]; also, randomized crossover trials suggest that a patient's baseline symptom severity can predict their clinical response to the intervention[3]. The advantages of avoiding fermentable carbohydrates seem to extend beyond the lower GI tract, with the potential to also

relieve comorbid dyspeptic symptoms[4]. Restricting these carbohydrates, however, has a profound effect on the ecosystem of the gut microbiota[5].

Conclusions: The low-FODMAP diet is an evidence-based approach for the treatment of IBS and other gastrointestinal disorders [2, 3], but given its known effects on the colonic microbiome, long-term compliance should be monitored to avoid changes in the microbiota [1, 5, 6].

Key words: IBS, low-FODMAP diet, FODMAP, irritable bowel syndrome

1. Introduction

1.1. IBS – Definition, Epidemiology and Methods of Treatment

Irritable bowel syndrome (IBS) is a common chronic gastrointestinal disorder that is characterized by recurrent abdominal pain, bloating, and altered bowel habits in the absence of organic diseases [7]. IBS is a relapsing and remitting multifactorial disorder of gut-brain interaction [8] and is classified into four subtypes according to predominant symptoms: IBS-C, IBS-D, IBS-M, and unsubtyped IBS [7]. The disease has a large global impact, with prevalence estimates ranging from 4% to 21%, and is twice as prevalent in Western females as in males [7]. The disease causes severe impairment in quality of life and poor social functioning, anxiety, and depression, and some patients would even be willing to take a 1% risk of sudden death if there was a 99% chance of being cured of symptoms [8].

Pharmacological treatments such as antispasmodics and laxatives are available, but they often provide only a modest therapeutic effect, and some have limited long-term efficacy or adverse effects [9]. Because new drug therapies provide a 10% to 15% therapeutic gain over placebos and sometimes are restricted or withdrawn, patients often seek other approaches [8]. Because food-related symptoms are reported in more than 80% of IBS patients, dietary changes that target the gut microbiota have emerged as a therapeutic strategy [8]. More recently, however, there has been an increased focus on nutritional changes and psychological interventions [10].

The low-FODMAP diet (restricting fermentable carbohydrates) is a widely accepted dietary treatment for IBS [8]. Short-chain fermentable carbohydrates that are not well absorbed by the small intestine and are rapidly fermented by gut bacteria produce more intestinal water and gas, leading to worsening of symptoms [9]. The low-FODMAP diet has three phases: an initial period of restriction (four to six weeks), a reintroduction phase to determine tolerance to individual foods, and a phase for creating a personalized modified diet [8]. There is evidence from clinical trials that the low-FODMAP diet provides relief from symptoms of IBS, including global IBS symptoms such as bloating and irregular bowel movements [8]. However, there is debate regarding the long-term nutritional adequacy, sustainability, and impact on the gut microbiome of the low-FODMAP diet [9].

1.2. Low-FODMAP Diet

Short-chain carbohydrates known as fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) are osmotically active [11, 12]. FODMAPs include fructose, lactose, fructans, galactans, and sugar alcohols such as sorbitol and xylitol [13], all of which are found in wheat, rye, vegetables, fruits, and legumes [13].

These particular carbohydrates are poorly absorbed from the small intestine and duodenum, or they are not absorbed at all [11, 12]. Once they reach the colon unabsorbed, they are rapidly fermented by gut bacteria [11], which produces short-chain fatty acids and gases (carbon dioxide, hydrogen, and methane) [11, 12], increases small intestinal water volume and exacerbates secretions [11, 12], and triggers gastrointestinal symptoms in IBS patients, including colonic gas production and intestinal motility issues [11, 12, 13].

The low-FODMAP diet (LFD) is a dietary approach that focuses on avoiding foods with these types of carbohydrates [12, 13] and has been shown to help reduce IBS symptoms [12, 13]. In fact, results from a recent network meta-analysis ranked the low-FODMAP diet number one against all other diets for bloating, severity of abdominal pain, and global symptoms [11]. Although several well-designed clinical trials assessing the efficacy of the LFD in IBS have reached somewhat controversial conclusions, this dietary approach may also be relevant for management of the IBS-type symptoms that afflict more than 30% of patients with inflammatory bowel disease (IBD) [11, 13]. While the LFD is currently under investigation as a potential therapy for IBS, these results cannot be easily applied to patients with IBD-IBS, who tend to have a more severe form of IBS [11, 13].

1.3. Low-FODMAP Diet – Phases

The low-FODMAP diet has been clinically implemented to treat IBS and is followed in a very specific protocol to balance symptom relief with nutritional adequacy [14, 15]. The first stage is the **Elimination Phase**, which is typically 2 to 6 weeks long, and involves a severe restriction of all high-FODMAP foods to greatly reduce functional GI symptoms [15, 16]. Once symptoms are adequately controlled, patients proceed to the **Reintroduction Phase**, in which specific groups of FODMAP carbohydrates are reintroduced in a systematic fashion to determine the individual dietary triggers and tolerance profiles [15]. The final stage is the **Personalization Phase**, which involves establishing a long-term, modified low-FODMAP diet that minimizes unnecessary dietary restrictions while still allowing the addition of health-promoting nutrients [15, 16, 17]. Scientific evidence cautions against straying from this strict three-phase protocol for the clinical application of the low-FODMAP diet.

2. Research Materials and Methods

A literature review was performed to summarize the current knowledge on the low-FODMAP diet for the management of IBS and emerging treatment perspectives, using a search strategy of PubMed combined with the following keywords: "FODMAP," "low-FODMAP diet," "irritable bowel syndrome," "IBS".

3. Research Results

Numerous recent studies have shown the clinical effectiveness of the low-FODMAP diet in treating functional gastrointestinal disorders, especially IBS, and systematic reviews and meta-analyses have reported that a large number of adult patients with IBS experience substantial improvement in their overall GI symptoms (e.g., bloating, abdominal pain, altered bowel habits) while following the diet [1, 2, 15]. In addition, a recent randomized crossover trial highlighted that not only is the clinical response to the diet significant, but also that the patient baseline symptom severity could be reliably used to predict the response to the diet [3]. Surprisingly, the low-FODMAP diet is not only effective in treating classical IBS but also in the management of gastrointestinal symptoms related to endometriosis [18]. That being said, in addition to these favorable clinical results, the focus on microbiome-based research warns

against the long-term strict application of the diet, with studies showing that the long-term strict adherence to the elimination phase induces significant changes in the gut microbiota, often reducing the abundance of health-promoting bacteria like *Bifidobacteria* [5]. As such, while the low-FODMAP diet has been established as an effective, evidence-based first-line therapy, investigators continue to emphasize the importance of a structured reintroduction phase to strike the right balance between adequate symptom control and long-term microbiome health [1, 5, 15].

4. Discussion

Although the low-FODMAP diet is an effective first-line therapy for IBS, long-term strict application poses considerable microbiome and nutritional challenges, and a structured reintroduction phase is critical for long-term gut health [1, 5, 15]. In addition, the carbohydrate-, dairy-, and produce-restricted diet may result in short-term deficiencies in total energy, fiber, calcium, iron, and some vitamins [1], but the diet appears to be ultimately nutritionally adequate, with malnutrition typically resulting from self-imposed restrictions common to IBS patients [1]. This suggests that ongoing dietary counseling and professional monitoring are essential to safely balance symptom management with microbiome and nutritional health [1].

4.1. Risks and Side Effects of the Low-FODMAP Diet

4.1.1. Impact of Dietary Restrictions on the Gut Microbiota

While these clinical results are encouraging, however, microbiome-focused research has been very critical of the long-term strict application of the diet, pointing to long-term adherence to the strict elimination phase as causing dramatic changes in the gut microbiota, often resulting in a reduction in the abundance of health-promoting bacteria like *Bifidobacteria* [5]. Thus, although research confirms the low-FODMAP diet as an effective, evidence-based first-line therapy, investigators consistently emphasize the need for a structured reintroduction phase to reconcile the need for effective symptom control with the preservation of long-term microbiome health [1, 5, 15].

4.1.2. Risk of Nutritional Deficiencies

New research into the nutritional adequacy of the low-FODMAP diet paints a complicated picture, especially when comparing short-term implementation of the diet with long-term habits. During the early stages of the diet, patients often encounter specific nutritional imbalances, including a fiber deficit, as a result of the need to restrict carbohydrate intake, excessive loss of calcium from the exclusion of dairy products, documented deficiencies of iron and several key vitamins (B1, B2, B9, and D), and overall lower energy intake that can contribute to unwanted weight loss [1].

Some of these immediate nutritional challenges are evident in clinical trials that have observed the short-term effects of the diet, although the results are sometimes inconsistent; a 2015 RCT showed that after four weeks, energy intake decreased for those on the low-FODMAP diet compared to those on the traditional dietary advice (TDA) plan, but the decline was greater in the low-FODMAP group, while a post hoc analysis of another RCT comparing the low-FODMAP diet to the modified NICE diet over a four-week period found that patients on the low-FODMAP plan had lower daily kilocalorie consumption and baseline micronutrients, with riboflavin reductions remaining significant even after adjusting for calorie intake, yet not all; another 2017 RCT found no difference in total calorie or macronutrient intake between the low-FODMAP diet and a sham diet [1].

Although short-term evidence suggests that the low-FODMAP diet may result in nutritional deficits, longer-term analyses indicate that it is nutritionally adequate and is no more nutritionally inadequate than a patient's usual diet [1]. Long-term follow-ups indicate that total energy and macronutrient intake are reduced, but researchers attribute that less to the rules of the low-FODMAP diet itself and more to the changed, general dietary habits of individuals with IBS, many of whom do not meet recommended dietary values regardless of their treatment [1].

The data seems to indicate that the diet itself is not the cause of the malnutrition; rather, self-imposed dietary restrictions and lack of dietary counseling are the main contributors to the nutritional deficiencies in the IBS population. The low-FODMAP diet is not without its risks, however, and regular monitoring by health professionals is needed to ensure that neither micro-nor macronutrient deficiencies occur [1].

4.2. The Role of Low-FODMAP Diet in the Treatment of Pediatric Patients

A systematic review of the literature identified a lack of high-quality clinical evidence to support the wide use of a low-FODMAP diet in pediatric and adolescent patients with FGIDs, and the available intervention trials were limited by methodological limitations, with evidence of low to very low quality due to a high risk of bias, which does not provide a strong empirical foundation to support definitive recommendations for clinical practice [19].

Despite these methodological limitations, the low-FODMAP diet has shown promise as a targeted therapy in the management of abdominal pain in a subset of pediatric patients with Irritable Bowel Syndrome (IBS) or Recurrent Abdominal Pain (RAP), with patient compliance being a high possibility (adherence >80%) and symptom interference with daily activities being reduced [19].

Secondary clinical outcomes show that the low-FODMAP diet has no therapeutic effect on stool consistency in this age group and that clinical responsiveness may depend on the composition of the baseline gut microbiome and the microbial metabolic capacity [19].

Overall, a low-FODMAP diet has good patient compliance and may be effective at reducing certain symptoms, such as abdominal pain, but the current evidence is not strong enough to warrant widespread clinical implementation, and further rigorous well-designed intervention studies are necessary before this dietary protocol can be formally recommended as a standard therapy for pediatric FGIDs [19].

4.3. Low-FODMAP Diet Treatment – Potential Predictors of Response

The low-FODMAP diet has been shown to be effective in treating the symptoms of IBS, but studies have begun to investigate baseline clinical, physiological, and biological markers of response to therapy to better predict response in patients, as current response rates range from 50% to 75% [1].

4.3.1. Clinical and Physiological Indicators

Initial evidence indicates that clinical response is associated with certain baseline patient profiles, with patients with more severe IBS symptoms (as measured by IBS-SSS) and higher levels of baseline anxiety being more likely to respond. Physiological reactivity can be

measured by diagnostic challenges; for example, a positive hydrogen breath test after a high-FODMAP meal, which is indicated by a rise in hydrogen levels above 10 PPM above baseline [1].

4.3.2. Microbiota and Metabolic Profiles

Dietary outcomes are determined by the baseline composition and metabolic activity of the gastrointestinal microenvironment. Responders often have a higher baseline abundance of specific bacterial taxa with greater saccharolytic metabolic capacity (family *Bacteroidaceae*, order *Clostridiales*, and family *Erysipelotrichaceae*), and patients with the so-called "pathogenic-like" microbiota subtype (enriched in Firmicutes and a paucity of Bacteroidetes) demonstrate significant clinical improvement. Higher colonic methane, increased saccharolytic fermentation, and particular volatile organic compound profiles also correlate with positive outcomes. Metabolomic analyses have recently validated that increased fecal propionate and cyclohexanecarboxylic acid esters are baseline biomarkers, and that unique urinary metabolites can identify responders versus non-responders [1].

These promising findings are, however, accompanied by conflicting data for individual microbial species such as *Actinobacter* and *Streptococcus*, which highlight the major heterogeneity of methodologies employed across contemporary literature, which warrants the use of more standardized study designs, uniform diagnostic criteria, and larger sample sizes to confirm these predictive response markers [11, 13].

5. Conclusions

The strong evidence from systematic reviews and network meta-analyses confirms that the low-FODMAP diet is a first-line, highly effective dietary therapy for IBS [7, 8, 10, 12]. Clinical trials have repeatedly shown that the rigorous elimination of fermentable carbohydrates results in statistically significant improvements in overall gastrointestinal symptoms (abdominal pain, gas, and bloating) and significantly improves quality of life for adult patients [2, 9, 13, 14]. In addition, when compared with other dietary treatments, such as a gluten-free diet or traditional symptom-based dietary advice, the low-FODMAP approach often shows strong and competitive clinical results [12, 16].

In addition to the management of IBS, the therapeutic value of FODMAP restriction continues to be explored for a broader range of gastrointestinal complaints, with recent studies indicating

that the baseline symptom severity of a patient can be used as a clinical predictor of their response to the diet to better tailor therapeutic approaches [3]. The diet has demonstrated great potential in alleviating overlapping dyspeptic symptoms and is increasingly being utilized as a therapeutic tool for the management of functional gastrointestinal disorders in pediatric and adolescent patients [4, 19], with demonstrable symptomatic relief in complex, overlapping conditions such as quiescent IBD, SIBO, and gastrointestinal distress caused by endometriosis [11, 18, 20, 21].

Although the clinical benefits of the diet are profound and widespread, a careful evaluation of the long-term physiological effects of the diet suggests extreme caution regarding the long-term use of the diet. Because fermentable oligo-, di-, and monosaccharides and polyols restrict all fermentable substrates to the lower gastrointestinal tract, systematic reviews of the colonic microbiome indicate that adherence to the strict elimination phase leads to rapid, significant, and potentially harmful changes in microbial composition [5, 6, 22]. The most frequently reported effect of this substrate deprivation is a significant reduction in the relative abundance of beneficial, short-chain fatty acid-producing bacteria—especially *Bifidobacteria*—along with a general decrease in microbial diversity and richness [5, 6].

These microbial shifts come with a number of nutritional risks, because the extremely restrictive nature of the diet will inevitably make it difficult to consume adequate amounts of dietary fiber, calcium, iron, and other essential vitamins over time, and will almost certainly result in unintended energy deficits [1]. The risk of malnutrition and unnecessary weight loss is greatly increased when patients implement such dietary changes on their own without supervision by a qualified healthcare professional [1].

Overall, the low-FODMAP diet is a potent and effective symptomatic management tool; however, it is crucial that the diet is implemented as a temporary, three-phased protocol rather than as a permanent lifestyle decision [1, 15]. To optimize therapeutic efficacy while minimizing the risks of nutritional deficiencies and microbiome dysbiosis, the strict elimination phase should be followed quickly by a structured reintroduction phase and long-term individualization, ideally under the guidance of a specialized dietitian [1, 5, 15]. Further research must focus on long-term safety assessments, the possible addition of health-promoting components, such as fermented foods, to compensate for dysbiosis, and the fine-tuning of personalized nutritional approaches for managing functional gastrointestinal disorders [1, 17].

Disclosure

Not applicable.

Author's Contribution

- **Conceptualization:** Hanna Ruszkowska, Karolina Stróżyk, Michalina Bąk
- **Methodology:** Karolina Stróżyk, Wiktor Zawadziński, Michalina Bąk
- **Resources:** Karolina Szamocka, Karolina Stróżyk, Wiktor Zawadziński
- **Data Curation:** Michalina Bąk, Karolina Szamocka, Hanna Ruszkowska
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Conflicts of Interest

The authors declare no conflict of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. AI were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

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