

The Role of Low FODMAP Diet in the Management of Irritable Bowel Syndrome

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ABSTRACT

Although irritable bowel syndrome (IBS) is the most common disorder in gastroenterological practice, therapy for this syndrome remains unsatisfactory. There has been a recent increase in the attention paid to the role of diet in IBS; among the putative dietary factors, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) are known to be important triggers of functional gastrointestinal symptoms. Emerging evidences have demonstrated the efficacy of a low FODMAP diet in the treatment of IBS. A recent randomized controlled trial demonstrated that scores for overall gastrointestinal symptoms, abdominal pain, bloating, and flatulence were significantly lower in participants who followed low FODMAP diets relative to those consuming typical Australian diets. This study provides high-quality evidence for the efficacy of a low FODMAP diet in the management of IBS and supports its use as a first-line IBS therapy. However, most studies examining low FODMAP diets in IBS have several limitations, which include relatively small sample sizes and short treatment periods. Furthermore, the majority

of these studies were performed in Western countries; therefore, as the generalizability of these results may be limited, studies investigating the effectiveness of the low FODMAP diet in non-Western populations are required.

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Key words: Irritable bowel syndrome; FODMAPs; Diet; Dietary therapy; Gastrointestinal symptoms

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INTRODUCTION

Irritable bowel syndrome (IBS) is a relatively common disease that affects approximately 15–20% of the general population^[1, 2]. Patients present with altered bowel habits and recurrent abdominal pain or discomfort, without evidence of an organic cause^[3]. The pathogenesis of IBS is multifactorial and includes disturbed gastrointestinal motility, visceral hypersensitivity, and abnormalities in brain-gut interaction^[4]. Acute or chronic inflammation, low-grade inflammation after an infectious event, immunologic dysregulation, and alterations to normal gut flora or intestinal endocrine systems are also suggested mechanisms^[5].

The role of diet in IBS has recently received increased attention^[6-13]. Dietary components, such as citrus fruit, cereals, dairy foods, and caffeine, have been suggested to play a major role in triggering symptoms^[14]. Fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) are also known to be important triggers of functional gastrointestinal symptoms^[15-17].

FODMAPs are poorly absorbed in the small intestine and therefore undergo fermentation in the large intestine, stimulating gas production and increasing the water content of bowel movements by exerting an osmotic effect^[18]. The human body lacks enzymes that break down oligosaccharides, such as galactan or fructan, and although variable according to patient ethnicity, the human body may lack enzymes that break down disaccharide, such as lactose, which are classified as FODMAPs^[19]. In addition, the absorption of monosaccharides, such as fructose, is markedly decreased when consumed with sufficient amounts of glucose, and polyols, which are absorbed by passive diffusion, are also classified as FODMAPs^[19].

Many studies have investigated the efficacy of a low FODMAP diet in clinical practice; however, most have methodological limitations and variable results. This review discusses the action mechanism of FODMAPs and the role of a low FODMAP diet in the management of IBS, using an evidence-based approach, with a focus on recent randomized controlled trials.

ACTION MECHANISMS OF FODMAPS

FODMAPs can exacerbate IBS symptoms through various mechanisms^[20, 21]. First, FODMAPs are poorly absorbed in the small bowel and they are osmotically active molecules.^[20, 21] Several studies revealed that FODMAP-rich diet led to higher effluent wet weight resulting from increased water content. This finding has been confirmed in studies using MRI to measure small intestinal water volumes following ingestion of some FODMAPs. For example, ingestion of 17.5g mannitol in healthy volunteers induced a 10-fold higher small intestinal water volume at 40 min than ingestion of an equi-osmolar glucose^[22] and similar results have been demonstrated after 40g fructose ingestion.^[23] Second, FODMAPs increase luminal H₂ and CH₄ production after fermented by colonic microflora, resulting in luminal distension and pain in those with visceral hypersensitivity.^[19, 20] Several breath test studies which measured fermented colonic gas such as H₂ and CH₄ demonstrate increased gas production both in healthy individuals and in patients with IBS.^[24] Third, FODMAPs also have an effect on motility. A scintigraphy study has demonstrated that fructose-sorbitol ingestion reduced orocecal transit time by just over 3h in healthy people. No difference in gastric emptying time was observed, indicating the difference was due to decreased small intestinal transit time.^[20] In another study, accelerated small intestinal transit was observed in 11 healthy volunteers after ingestion of fructose-sorbitol in comparison with glucose.^[25]

INTERACTIONS BETWEEN FODMAP AND SIBO

Small intestinal bacterial overgrowth (SIBO) is the abnormal growth in the small intestine of bacteria that are normally found only in the colon^[19]. The symptoms of SIBO are nonspecific and overlap with IBS.^[26] High FODMAPs act as a nutrition source for small bowel and colonic bacteria, resulting in excess fermentation and gas production. A low FODMAP diet has been recommended in the treatment of functional gastrointestinal symptoms^[13, 27] and shown to be effective in short-term management of IBS patients.^[28] However, it is unclear whether clinical improvement from low FODMAP diet is a result of a modulated microbiota composition or simply from a reduction in fermentation and gas production.^[29] Dietary modification should be considered in patients with SIBO, but its role and efficacy have yet to be determined^[29].

CLINICAL EFFICACY OF A LOW FODMAP DIET

Retrospective and prospective studies

The relationship between dietary FODMAPs and gastrointestinal symptoms first received attention in 2001 in studies conducted by Gibson *et al* at Monash School of Medicine^[30]. These authors reported that a FODMAP-rich diet increased the risk of Crohn's disease. Several other studies have since reported on the mechanisms underlying the impact of FODMAPs on intestinal function, and the therapeutic role that a low FODMAP diet may play for patients with IBS-related gastrointestinal symptoms^[18, 31-40].

Retrospective studies have evaluated the efficacy of a low FODMAP diet in the treatment of IBS. For example, Shepherd *et al*^[34] reviewed 62 IBS patients over a period of 2–40 months (median: 14 months) subsequent to initial dietary instruction concerning fermentable carbohydrate restriction; 74% of patients reported an improvement in symptom scores. In a study by Gearry *et al*^[35], 72 patients with inflammatory bowel disease and concurrent functional symptoms were assessed via telephone questionnaire after receiving initial dietary advice. Approximately half of those who received dietary advice responded and reported a reduction in symptom scores. A case-control study including 42 control participants, 70 IBS patients who had received dietary advice (“guided” patients), and 63 IBS patients who had received no advice (“unguided” patients), noted alleviation in abdominal pain and greater improvement in quality of life in the guided group relative to the unguided group^[36].

A New Zealand-based prospective uncontrolled trial involving 90 IBS patients, followed up for a mean duration of 15.7 months, showed significant alleviation of gastrointestinal symptoms, such as abdominal pain, bloating, flatulence, and diarrhea, with a low FODMAP diet; 72% of patients were reportedly satisfied with the severity of their symptoms. Malabsorption of fructose or lactose and small intestinal bacterial overgrowth were combined in 75.6%, 37.8%, and 13.3% of patients, respectively; fructose malabsorption was significantly associated with symptom reduction subsequent to following a low FODMAP diet^[37]. Other prospective studies have demonstrated the beneficial effects of FODMAP-related dietary guidance^[38] and intervention^[39] on overall IBS symptoms and quality of life. A nonrandomized controlled trial conducted in England compared IBS patients who followed a low FODMAP diet with those who received standard dietary advice^[40]. At a follow-up appointment 2–6 months subsequent to receipt of dietary advice, a greater proportion of patients who had followed a low FODMAP diet were satisfied with their symptom reduction, relative to those who received standard dietary advice (76% vs 54%, $P = 0.038$). This is the only study that has compared fermentable carbohydrate restriction with another dietary intervention; however, it was limited by lack of randomization and the fact that patients who did not return to the clinic were not followed up^[20].

These various retrospective and prospective uncontrolled studies provide important data relating to the use of a low FODMAP diet in the treatment of IBS. However, the nonrandomized nature of the studies and a lack of follow-up periods of sufficient duration make it impossible to draw confident conclusions regarding an effective dietary protocol for IBS patients.

Randomized controlled studies

A randomized, double-blinded, placebo-controlled, quadruple-arm, rechallenge trial was conducted to determine whether the

effectiveness of low FODMAP diets in IBS patients was due to a reduction in either fructose or poorly absorbed, short-chain carbohydrates^[41]. Twenty-five patients with IBS showed fructose malabsorption on fructose breath tests and experienced a reduction in symptoms while following a low FODMAP diet. Inadequate symptom control was reported in 70% of patients receiving fructose, 77% of patients receiving fructans, and 79% of patients receiving a mixture of fructose and fructans, relative to 14% of patients receiving glucose. All IBS symptoms were significantly more severe in patients who received fructose, fructans, or a combination of the two, relative to those who received glucose. IBS symptoms worsened in a dose-dependent manner, and the effects of fructose and fructans were additive. This study provides strong evidence that FODMAPs could induce symptoms, at least in a subset of IBS patients.

Another randomized controlled trial investigated the effects of fermentable carbohydrate restriction on gastrointestinal symptoms in IBS patients randomized to receive dietary advice or continue with their habitual diets for 4 weeks. Validated methods of evaluating symptoms and stool output were used to assess outcomes, and a semi-quantitative food record enabled careful assessment of dietary intake^[42]. Adequate relief from symptoms was reported in 68% of patients receiving dietary advice relative to 23% of patients in the control group, who continued to follow their usual diets. However, the treatment group was not blinded to their intervention, which is a common problem in dietary intervention trials^[20].

Ong *et al*^[24] conducted a single-blind, crossover intervention trial to examine the effects of a low FODMAP diet on hydrogen gas production in IBS patients. Fifteen IBS (Rome III criteria) patients and 15 healthy control participants underwent breath tests while following a low (9 g/day) or a high (15 g/day) FODMAP diet for 2 days. Subsequent to a 7-day washout period, participants followed the alternate diet. IBS patients who followed high FODMAP diet produced a significantly greater amount of hydrogen gas relative to those who followed a low FODMAP diet. Regardless of diet, IBS patients produced more hydrogen gas relative to the control participants. A composite IBS symptom score that included the most commonly reported IBS symptoms was significantly higher for IBS patients who followed a high FODMAP diet relative to those who followed a low FODMAP diet. This study showed that FODMAPs increase intestinal hydrogen production, indicating the occurrence of bacterial fermentation, thus causing increased gastrointestinal symptoms in patients with IBS relative to control participants.

Halmos *et al*^[43] recently performed a single-blind, randomized, controlled, cross-over clinical trial to compare the effectiveness of a low FODMAP diet to that of a typical Australian diet (TAD) in unselected IBS patients. In contrast to the results of previous studies comparing low and high FODMAP diets, the TAD used in this study was more representative of usual dietary circumstances. Dietary intake was recorded in a food diary during the first week, whereupon participants were randomized to follow either a low FODMAP diet or TAD for 21 days. Thereafter, participants entered a washout period of at least 21 days, in which they resumed their usual diet prior to following the alternate diet. The study included 8 healthy control participants and 30 patients with IBS, defined using Rome III criteria. Overall gastrointestinal symptom scores (OGISSs) recorded via the visual analogue scale (VAS) were 22.8 mm in the low FODMAP group and 44.9 mm in TAD group ($P < 0.001$); the scores for abdominal pain, bloating, and flatulence were significantly lower in the low FODMAP group relative to those of the TAD group. The baseline OGISS for the IBS group was 36.0 mm, which is similar to that reported in previous studies. Increasing differences in OGISS

between participants who followed the low FODMAP diet and those who followed the TAD were observed subsequent to the first 7 days of the dietary intervention period and thereafter maintained. A greater portion of participants who followed the low FODMAP diet recorded a VAS score of 10 mm relative to those who followed the TAD (70%). In addition, abdominal pain, bloating, flatulence, and dissatisfaction with stool consistency were significantly reduced with the low FODMAP diet in IBS patients, but this was not observed in healthy control participants. This study had some limitations, including a limited patient sample ($n = 30$) and a relatively short treatment period (21 days), which make it impossible to predict the long term effects of a low FODMAP diet^[44]. However, the result of this well-designed study provide high-quality evidence regarding the efficacy of a low FODMAP diet in the treatment of IBS patients and support its use as a first-line therapy.

CONCLUSION

In conclusion, most studies, including another recent single-blinded, randomized, controlled, cross-over trial, have demonstrated the therapeutic benefit of a low FODMAP diet for IBS patients; therefore, the role of the low FODMAP diet should be further elucidated in future therapeutic trials. However, different kind of food and different culture relating to diet should be considered, as the majority of these studies were undertaken in Western countries. As the results of previous studies may not be generalizable to non-Western countries, further studies examining the effectiveness of the low FODMAP diet in non-Western populations are required.

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