



Does Low Fermentable Oligosaccharides, Disaccharides, Monosaccharides, And Polyols Diet Cause Symptomatic Improvement In Adults With Irritable Bowel Syndrome?

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

There is an ongoing interest in the interaction between diet and the Gastrointestinal symptoms experienced in Irritable bowel syndrome. Dietary restriction of short-chain fermentable carbohydrates (the low fermentable oligosaccharide, disaccharide, monosaccharide, and polyol (FODMAP) diet) is now frequently used in the clinical context. There are currently numerous randomized controlled trials showing that the low FODMAP diet leads to clinical response in IBS patients. This review intends to present recent advancements in the understanding of the mechanisms by which the low FODMAP diet influences symptoms in IBS, restriction, reintroducing FODMAP diet, and suggestions for areas for forthcoming research.

Keywords: Irritable Bowel Syndrome, FODMAP

Introduction

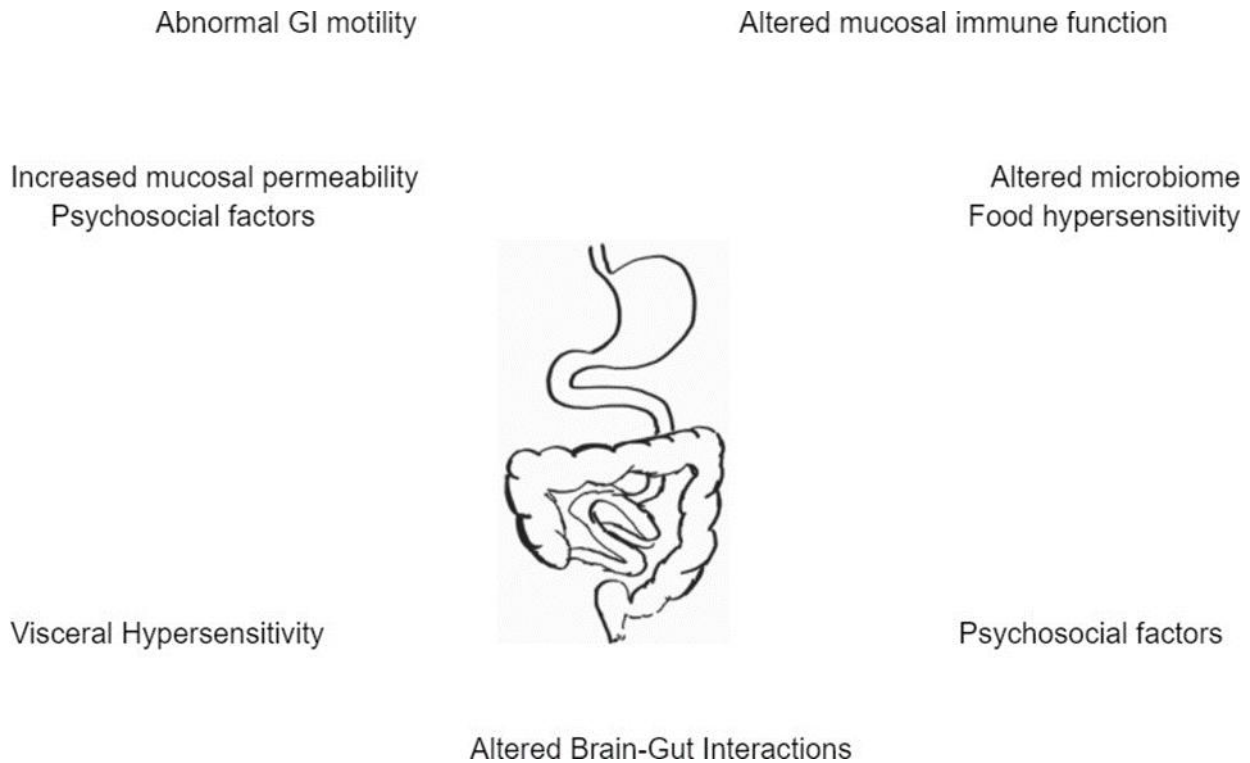
WORLDWIDE, Functional bowel disorders are highly prevalent with the potential to affect all members of society. Irritable bowel syndrome is a functional disorder of the bowel with symptoms of altered bowel habits such as constipation, diarrhea, abdominal pain, bloating without any underlying organic disease^[1]. The prevalence of Irritable bowel syndrome worldwide is 10 – 20 %^[2] and is widely stigmatized. Irritable bowel syndrome is no longer idiopathic but a more complex disorder with multiple causation factors. To be precise, visceral hypersensitivity [increased perception of signals from the bowel], gastrointestinal motor activity alterations, and psychological stress play the main mechanisms in this disorder^[3]. Adding on to these mechanisms,

recent studies show modifications of the gut microbiota, immune system, and intestinal permeability in patients with IBS, but further studies are needed to confirm its role^[4].

Food plays the central and most recurring problem in patients with IBS^[5]. Despite people avoiding foods triggering symptoms, their nutritional intake was sufficient^[6,7]. Current diet recommendations in IBS patients are solely based on physiological food effects rather than on controlled trials.

Presently, a diet low in FODMAPS has been gaining momentum in targeting symptoms of IBS. This review aims to conduct a traditional review to evaluate the available evidence and determine whether a low-FODMAPs diet alleviates IBS symptoms.

Figure 1. Pathophysiologic mechanisms of irritable bowel syndrome



Discussion

Epidemiology

Oka et al. ^[8], in her systematic review and meta-analysis, confirmed that IBS, a global and highly prevalent disorder with incidence using ROME III criteria, is 9.2 %, and it was double the incidence than those based on ROME IV criteria(3.8%)

According to the authors, the prevalence of IBS based on ROME IV criteria was 9.1 % in the USA and 0.2% in INDIA. Countries including GHANA, CHINA, TURKEY, SINGAPORE, and MALAYSIA have a prevalence of less than 2 %.

Criteria For Diagnosing Irritable Bowel Syndrome

From MANNING et al. presenting the first IBS criteria, it evolved to ROME I, II, III, IV criteria [9]

MANNING	1978
ROME I	1994
ROME II	2000
ROME III	2006
ROME IV	2016

Table 1. Criteria For Diagnosing Irritable Bowel Syndrome

	MANNING	ROME I	ROME II	ROME III	ROME IV
Abdominal pain	The onset of pain linked to more frequent bowel movements	Abdominal pain and discomfort	Abdominal pain or discomfort for twelve weeks (needn't be consecutive) in preceding twelve months with two /more of the following	Recurrent pain abdomen or discomfort at least three days/month in the last three months associated with two or more of the following	Recurrent pain abdomen, at least one day/ week in the last three months [on average], associated with two or more of the following criteria
Relief of pain	Looser stools associated with pain and relief with defecation	Pain relief with defecation	Relief with defecation	Improvement with defecation	Related to defecation
Association with stool frequency and consistency	Bloating of abdomen /visible abdominal distension	Associated with Change in frequency and consistency	ONSET associated with a Change in frequency and consistency	ONSET associated with a Change in frequency and consistency	Associated with a Change in frequency and consistency
Additional features	The sensation of incomplete evacuation >25% of the time Diarrhea with mucus >25% of the time	Two/more of the following at least on one-fourth of occasions/days: Altered –stool frequency – stool form – stool passage			

		– Passage of mucus and/or Bloating or feeling of distended abdomen			
Criteria	The patient should meet \geq three criteria			Criteria fulfilled for the last three months and symptom onset should be at least six months before diagnosis	Criteria fulfilled for the last three months and the onset of symptoms at least six months before diagnosis

IBS SUBTYPES ^[10]:

	Loose Stools	Hard Stools
IBS-Constipation	Less than 25%	Greater than 25%
IBS-Diarrhea	Greater than 25%	Less than 25%
IBS-Mixed bowel habits	Greater than 25%	Greater than 25%
IBS -unclassified	Less than 25%	Less than 25%

Patients with IBS can quickly identify their type of stool with the help of a bristol stool scale with stools ranging from type (firm balls) to Type 7 (Thin Liquid). The red flag symptoms^[11] include old age>50, family history of inflammatory bowel disease or colon cancer, fever, bloody stool, nocturnal symptoms, especially diarrhea weight loss, abnormal laboratory tests including elevated inflammatory markers.

Irritable Bowel Syndrome Management

Improving the quality of life, reducing stress, and controlling symptoms remain the mainstay of treatment. The goal is to create a patient-physician relationship that leads to successful management of Irritable bowel syndrome

Fodmaps

FODMAPs are poorly absorbed short-chain carbohydrates in the gastrointestinal tract ^[2]. Fructose (monosaccharide), lactose (disaccharide), fructans

and galactans (oligosaccharide), and sugar alcohols (sorbitol, maltitol, mannitol, xylitol, and isomaltose) are the short-chain carbohydrates. ^[12].

Monosaccharides

Fructose is the smallest FODMAP. It is a monosaccharide and is a digested product of sucrose. Dietary sources include fruits (apples, mango, pear, watermelon), vegetables such as peas, and sweeteners such as honey and high-fructose corn syrup^{[13][14]}.

Disaccharides

Lactose, a disaccharide from milk and milk products, is digested into glucose and galactose by lactase.

The deficiency of lactase or diminished activity results in incomplete or indigestion of lactose reaching the colon as unabsorbed lactose^[15].

Oligosaccharides

Oligosaccharides, fructans/fructooligosaccharides (FOS), and galactans/galactooligosaccharides (GOS) have the most extended chain length^[13].

Fructans are found mainly in wheat, rye, barley, and onions, while galactans such as raffinose are primarily found in legumes^[14].

Sorbitol, mannitol, and sweeteners such as xylitol, maltitol, isomaltose are polyols ^[14]. Dietary sources include apples, cauliflower, mushrooms, pears, and peas.

MECHANISM of FODMAPS triggering IBS:

Diet with Low FODMAP could decrease Irritable bowel syndrome symptoms through various mechanisms.

High FODMAPS result in bowel distention due to the osmotic effect of FODMAPs and gas production

resulting from fermentation in the colon ^[16,17]. Increasing small intestinal water is one of the established mechanisms by which FODMAPS induces symptoms in IBS patients[18]. Barrett al, In their randomized, single-blind crossover study, compared a High fodmap diet with a low FODMAP diet in 10 patients who underwent ileostomy. The study showed a twenty percent increase in effluent water content^[19]

When undigested /non-absorbed short-chain carbohydrates reach the colon, resident bacteria use them as substrates for fermentation, producing SCFA, hydrogen, and methane leading to luminal distension and provoking IBS symptoms^[14]. Ong et al., in their randomized, single-blind crossover study, compared the production of breath hydrogen and methane. In 15 healthy and IBS patients. According to Ong et al., higher breath hydrogen levels were present over the entire day in IBS patients^[16].

The bowel distention activates nociceptors and enteric reflexes resulting in symptoms worsening when patients have underlying visceral hypersensitivity, ^[17] a common feature in IBS. McIntosh et al. concluded that FODMAP content and alterations in metabolome are associated with IBS symptoms^[20]. Other studies suggest FODMAPs may improve depression. Since BRAIN GUT AXIS plays a vital role in IBS and depression is linked to low-grade inflammation in IBS, ^[21] this implies interaction between the immune system and FODMAPs.

IBS and its association with alterations in gut motility, gut barrier function, immune regulation, and visceral hypersensitivity can be affected by the gut microbiome ^[22,23,24]

Examples Of Low Fodmap Diets

Table 2. ^{[25][26]}

	LOW FODMAP FOODS examples
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FRUITS	Papayas, pineapples, bananas (unripe), blueberry, raspberry, strawberry, passionfruit, cantaloupe, grapes, kiwifruits, lemons, limes, mandarin oranges
VEGETABLES	Radishes, spinach, tomatoes, olives, bok choy, broccoli, carrots, chives, cucumbers eggplants, kale, lettuce, mushrooms (oyster), bamboo shoot, choy sum, corn, eggplant, green bean, lettuce, parsnip, pumpkin, silverbeet, spring onion (green part only)
GRAINS	Breads, oatmeal, potatoes, popcorn, rice, sourdough, bread quinoa, corn tortillas/ chips grits, gluten-free pasta, crackers
DAIRY PRODUCTS	Lactose-free milk, rice milk, gelato, sorbet, hard cheese
PROTEINS	tofu (firm) ,beef, chicken ,eggs, fish/seafood, pork ,turkey, edamame ,lentils ,canned/rinsed

Table 3. Randomized Controlled Trials Comparing Low Fodmap Diet With Other Diets

Author	Intervention [n=number]	Control [n=number]	Study duration	Result
1. Ong et al, 2010[16]	LFD (9 g FODMAPs/day)	HFD (50 g/day) n =15	4 days	Primary outcome Reduction in IBS symptoms

	n =15			
2. Staudacher et al, 2012[27]	LFD n =42	Habitual diet n =40	4 weeks	Primary outcome Reduction in IBS symptoms
3. Halmos et al, 2014[28]	LFD n =30	typical Australian diet n =30	42 days	Primary outcome: according to VAS , reduction in IBS symptoms
4. Pedersen et al, 2014[29]	LFD n =42	Danish/Western diet n =40	6 weeks	Primary outcome: reduction in IBS-SSS score
5. Bohn et al, 2015[30]	LFD n =33	traditional IBS diet n =34	4 weeks	Primary outcome: reduction in IBS –SSS score
6. Laatikainen et al, 2016[31]	LFD n =37	Traditional rye bread n =36	4 weeks	Primary outcome: Milder reduction in symptoms
7. Eswaran et al, 2016[32]	LFD n =43	traditional IBS diet n =39	4 weeks	Primary outcome:50% reduction in IBS symptoms

8. Harvie et al, 2017[33]	LFD n =23	No dietary intervention n =27	3 months	Primary outcome: reduction in IBS –SSS, and increase in IBS QOL
9. McIntosh et al, 2017[20]	LFD n =18	HFD n =19	21 days	Primary outcome: reduction IBS-SSS
10. Staudacher et al, 2017[34]	LFD n =51	sham exclusion diet n =53	4 weeks	Primary outcome:50 point reduction in IBS –SSS and adequate relief of symptoms
11. Eswaran et al 2017[35]	LFD n =45	mNICE n =39	4 weeks	Primary outcome: Quality of life improved
12. Hustoft et al,2017[36]	LFD Crossover design[n=25]	HFD	9 weeks	Primary outcome: reduction in IBS-SSS score
13. Zahedi et al, 2018[37]	LFD (<0.5 g of FODMAPs per meal) n =50	traditional IBS diet n =51	6 weeks	Primary outcome: reduction in IBS-SSS
14. Pirkola et al,2018[38]	LFD n =7	Regular rye bread n =7	1 day	Primary outcome: reduction in IBS symptoms

15. Paduano et al, 2019[39]	LFD n =34	Balanced Mediterranean diet n =28	12 weeks	No significant difference
16. Patcharatrakul et al, 2019[40]	Personalized LFD n =30	Common. diet for IBS n =32	4 weeks	Primary outcome: reduction in IBS-SSS
17. Guerreiro et al, 2020[41]	LFD n =47	NICE n =23	4 weeks	Primary outcome: reduction in IBS symptoms
18. Krieger et al, 2020[42]	LFD n =22	Low lactose Diet n =24	3 weeks	Primary outcome: reduction in IBS-SSS
19. Wilson et al, 2020[43]	LFD n =23	Sham diet n =23	4weeks	Primary outcome: reduction in IBS symptoms
20. Goyal et al, 2021[44]	LFD n =51	Traditional diet n =49	4 weeks	Primary outcome: reduction in IBS-SSS

LFD Low FODMAP diet , HFD High FODMAP diet, IBS-SSS irritable bowel syndrome – severity scoring system, IBS-QOL irritable bowel syndrome quality of life, VAS visual analog scale

COMPARISON between Low FODMAP diet and various diets:

TABLE (2) includes all the randomized control trials comparing Low FODMAP with different other dietary patterns. From the trials, symptoms of Irritable Bowel syndrome reduced with LOW FODMAP DIET. Many trials focussed on the restriction of low FODMAP and concluded its outcomes. Goyal et al.,^[44] in their trial, reported that after reintroducing a FODMAP-rich diet, IBS improvement was sustained along with improvements in stool frequency and consistency.

Further studies are required regarding rechallenging and reintroduction of High FODMAPS in IBS patient diet.

TABLE 4. Phases of Low FODMAP

RESTRICTION	DURATION:4 to 6 weeks	Low FODMAPS substituted for High FODMAP
RECHALLENGE	DURATION:6 to 8 weeks	FODMAP rich foods are reintroduced one by one and food inducing symptoms can be identified
REINTRODUCTION	DURATION: Long term	Reintroduced well-tolerated FODMAPS and restrict FODMAP triggering symptoms

Limitations In Low Fodmap Diet

Owing to the heterogeneous nature of the bowel disorder, management strategies are still evolving. Patients and physicians are waiting for the most specific treatment targeting the multifactorial pathophysiology of IBS, its subtypes, and cost-effective medication^[46]. Most of the published studies comparing low fodmap with other traditional diets had their own limitations like short-term study, choice of control, and blinding^[46]. According to Staudacher et al, blinding is a problem because patients became aware while consuming foods, and such diets and feeding habits could not reflect real-life eating behavior^[47].

Since it has been well established that food, antibiotics, and infections control microbial activity in the gastrointestinal tract^[48]. A study after restricting FODMAP for 4 weeks observed a reduction in Bifidobacterium. ^[49].In another study by Halmos et al, observed a marked reduction in Clostridium coccoides and Akkermansia muciniphila and an increase in Ruminococcus torques^[50]. Such

alterations in microbiota alter in consuming strict Low FODMAP diet. A low fodmap diet is complex, and patients find it difficult to follow and are expensive, requiring a highly motivated patient. This plays an important for the principle of adherence.

Prescribing a low fodmap diet requires a wide level of knowledge of nutrition and dietary options, and involving a dietician plays a vital role in these situations. Group education cuts down the expenses of one-to-one counseling. One such study in the UK showed a significant reduction in cost with no difference in IBS symptom reduction between the group and one on one counseling^[51].

Conclusion

The Low FODMAP diet has become an integral component in managing irritable bowel syndrome. This is a step towards managing medical disorders not only by medical drugs but by implementing changes in lifestyle activities, including dietary options. With the evolving medical field and evolving medical management options, the

implementation of Low FODMAP is the beginning. With multiple studies focussing on the effectiveness of low FODMAP over other diets, future studies should focus on rechallenging, reintroducing FODMAP diets.

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