Review Article

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Dietary strategies for irritable bowel syndrome: A narrative review of effectiveness, emerging dietary trends, and global variability

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Abstract
Background – Various dietary strategies have been proposed for irritable bowel syndrome (IBS) symptom relief; yet, long-term studies and comparative trials remain limited. The literature reports inconsistent findings regarding the nutritional adequacy and global variability of dietary intake in IBS populations, highlighting the need for a broader understanding of how cultural and emerging dietary factors influence symptom expression.
Objective – This narrative review aims to evaluate the effectiveness of predominant dietary interventions for IBS, provide an overview of emerging dietary trends, and examine cultural differences in dietary patterns among IBS populations.
Methods – A comprehensive search was conducted across Google Scholar, Wiley Online Library, PubMed, Elsevier, Scopus, and ScienceDirect for peer-reviewed, English-language articles published after 2000. Studies included clinical guidelines based on systematic reviews, analyses of dietary intakes in IBS populations adopting alternative dietary assessment methods, and reviews of dietary interventions. One hundred and ten studies were included following title, abstract, and full-text screening.
Key findings – Due to the heterogeneous nature of IBS, various dietary strategies are reported. Yet, it remains unclear which is superior, with the low-FODMAP diet being the most studied. Emerging dietary trends show promising potential, but current evidence is preliminary and requires long-term investigations. Internationally, dietary intake patterns vary, with some IBS populations meeting nutritional needs while others exhibit deficiencies, particularly in fibre, calcium, iron, and B vitamins.
Conclusion – Given the variability in IBS responses, tailored dietary management is essential. Furthermore, long-term, comparative, and cross-national studies are needed to address global nutritional gaps and inform standardised dietary guidelines for IBS.

Keywords: irritable bowel syndrome, dietary intake, nutritional adequacy, emerging dietary trends, cultural diversity, low FODMAP diet

1 Introduction

Irritable bowel syndrome (IBS) is a chronic gastrointestinal (GI) disorder characterised by recurrent abdominal pain and altered bowel habits, including diarrhoea, constipation, or a combination of both. The pooled global prevalence is estimated as 11.2% with a cross-national variation of 1.1–45.0% [1–3]. One meta-analysis of 57 cross-sectional studies suggests a global prevalence rate of 3.8% on employing the Rome IV symptom-based diagnostic criteria [3]. According to a global study conducted by the Rome Foundation, the prevalence of IBS based on internet surveys ranges between 3 and 5% while the prevalence based on household surveys showed a wider range of 0.2–4.6%, with greater variability observed in the latter [4]. IBS is a significant contributor to healthcare utilisation and impacts the quality of life of millions of individuals. Despite extensive research, its pathophysiology remains complex and poorly understood largely due to its multifactorial nature, involving the gut–brain axis, motility disturbances, visceral hypersensitivity, and alterations in the gut microbiota [5–8].

Traditional management strategies for IBS include pharmacological interventions aimed at alleviating symptoms [9–11] and psychological strategies such as cognitive behavioural therapy and gut-directed hypnotherapy [12]. Over the past years, dietary interventions have gained more attention and included within IBS guidelines in light of the growing body of evidence about the important role that dietary interventions may play in the management of IBS symptoms [13].

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Diet presents a potential underlying pathological mechanism as certain foods and eating patterns may trigger symptoms. Food intolerance and allergy, bacterial overgrowth, and postprandially altered colonic flora and GI physiology are amongst the potential mechanisms proposed for triggering food-induced symptoms [14]. Therefore, various dietary strategies have been explored aimed at reducing symptom severity and improving overall GI function [15].

With the growing awareness regarding the potential role that diet can play in the relief of IBS symptoms, emerging dietary trends including artificial intelligence-assisted personalised diets using microbiome testing [16–18], plant-based diets (PBDs) [19–23], the Mediterranean diet (MD) [24–29], and intermittent fasting (IF) [30,31] amongst others are being explored for their potential effectiveness.

The available literature on the dietary intake of international IBS populations presents heterogeneous conclusions. Some studies suggest that IBS does not adversely affect nutrient intakes, while others report specific nutritional deficiencies [32–38]. These conflicting findings highlight the complexity of dietary management in IBS and the influence of cultural diversity on dietary intake. Such conclusions emphasise the need for further investigation into the nutritional impact of the disorder across diverse populations.

This narrative review aims to critically evaluate the effectiveness of established dietary interventions in the management of IBS symptoms while acknowledging the inherent complexity and heterogeneity of this disorder of gut-brain interaction. In addition to synthesising current evidence on widely adopted dietary strategies, this review explores emerging dietary trends and their potential therapeutic relevance. This review provides further unique value through the analysis of dietary intake patterns of IBS populations across diverse geographical regions, highlighting the influence of cultural and regional diversity which is often overlooked. Unlike systematic reviews, this narrative synthesis is based on the relevance and contribution of selected studies to the field, rather than on rigid inclusion and exclusion criteria. By integrating findings from various sources, this review contributes to a more nuanced understanding of IBS dietary management and identifies areas for future research.

2 Methodology

A narrative review approach was selected to allow flexibility in synthesising a diverse body of literature, including clinical guidelines, observational studies, and emerging evidence on novel dietary interventions. A thorough literature search was conducted between September 2023 and May 2025 across major databases including Google Scholar, Wiley Online Library, PubMed, Elsevier, Scopus, and ScienceDirect. Studies were categorised based on their primary research focus: dietary management strategies, evaluation of emerging dietary interventions, and assessment of dietary intake in IBS populations.

Study selection was limited to that available in the English language, peer-reviewed, and published after the year 2000 with emphasis on studies published within the last 10 years. Given the challenges to evaluate the dietary intake of such an intricate population, studies of varying sample sizes were included and assessed based on their methodological rigour. Studies selected include clinical guidelines based on systematic reviews, studies comparing cross-sectionally collected dietary intakes or pre-existing dietary data of IBS populations with that of non-IBS counterparts and/or dietary reference values, studies adopting alternative dietary assessment methods, mainly validated food frequency questionnaires and food and beverage diaries, reviews comparing alternative dietary management strategies for IBS and studies assessing the effectiveness of emerging dietary interventions. Studies that specifically investigated the effect of diet on intestinal dysbiosis were excluded since these were outside the scope of this review. Moreover, grey literature was also excluded to maintain the inclusion of peer-reviewed, high-quality sources.

A two-stage screening process was performed: title and abstract review followed by full-text review. All eligible studies were included yielding a total of 110 studies. Fifty-four of such studies evaluated dietary strategies for the management of IBS symptoms, 31 provided evidence for emerging dietary trends, and 25 reported on the dietary intakes of cross-national IBS sufferers.

3 Discussion

Dietary interventions have emerged as a cornerstone in the management of IBS, offering a non-pharmacological alternative to symptom management and improvements in the quality of life [13]. Given the complexity of IBS with its heterogeneous symptomatology and the interplay of physiological and psychological factors together with the myriad of triggers, various dietary strategies have been proposed, each targeting different aspects of the condition. Notably, findings from the CARBIS trial demonstrated that dietary interventions were effective and safe alternatives to pharmacological therapy in reducing IBS symptom severity, reinforcing the role of diet as a safe and viable first-line treatment approach [39]. The most prominent and widely adopted dietary interventions are reviewed in this section, with a focus on their mechanisms of action, efficacy, limitations, clinical applications, and potential directions for future research.

3.1 Traditional dietary advice (TDA)

TDA follows dietary recommendations established by the British Dietetic Association (BDA) and the National Institute for Health and Care Excellence (NICE) [10,40]. In 2016, the BDA provided the first fully comprehensive evidence-based first-line dietary and lifestyle guidelines for the dietary management of IBS with advice related to healthy eating practices, the consumption of alcohol, caffeine, fluids, fat, fibre, dairy, spicy food, and the use of probiotics as summarised in Table 1 [40].

Evidence suggests that irregular meal patterns, low fruit and vegetable intake, and excessive fast-food consumption may trigger IBS symptoms [10,40]. Therefore, monitoring dietary habits and promoting a balanced diet alongside healthy eating and lifestyle practices is recommended.

Both the BDA and NICE recommend TDA as a first-line treatment prior to consideration of more restrictive diets like the low fermentable oligosaccharide disaccharide monosaccharide and polyols (FODMAP) diet (LFD) [10,40]. Although TDA is widely implemented in clinical practice, the supporting evidence is relatively limited. Most of the recommendations are informed by clinical experience, observational findings, or expert consensus rather than a robust foundation of randomised controlled trials (RCTs). One notable RCT by Eswaran et al. [41] included TDA as a comparator to the LFD and concluded that while TDA may offer symptom improvement for some individuals, the LFD resulted in significantly greater symptom relief. However, the existing lack of large-scale, well-designed trials evaluating TDA as a standalone intervention restricts our ability to draw strong conclusions about its efficacy. Despite these limitations, TDA remains a practical, cost-effective, and nutritionally balanced approach, especially for individuals

Table 1: Key recommendations proposed by the BDA [40]

Food source or group	Mechanism	Impact or response by the body	Recommendation
Alcohol	Influence GI transit, absorption, and intestinal permeability	Abdominal pain, nausea, indigestion, diarrhoea on excessive consumption	Abide by recommended safety limits with even more strict intakes if symptoms worsen
Caffeine	Induces gastric acid secretion, colonic motor activity, and rectosigmoid motor activity	Gastroesophageal reflux, dyspepsia, abdominal pain, loose stools	Symptoms should be monitored and intakes restricted accordingly
Fluids	May improve stool frequency		Gradual increase in fluid intake aiming 1.5–3 litres daily
Lipids	Stimulate the reflex controlling motility of low GI tract after food intake	Abdominal pain, dyspepsia, flatulence	Reduction in meal fat content
Fibre	May improve stool consistency and/or frequency and has beneficial effects on GI microbiota and fermentation by-products	Inadequate or excessive intakes may worsen IBS symptoms of abdominal pain and constipation	If fibre intake is to be improved, a varied consumption of high fibre starchy sources coupled with adequate intake of non-caffeinated and non-alcoholic drinks is encouraged
Lactose	Malabsorption in the presence of insufficient amounts of lactase	Bloating, abdominal pain, excessive flatus	Should be considered as part of a low-FODMAP diet Lack of high-quality data to recommend milk-free diets for IBS symptom management
Spicy food (capsaicin)	Stimulates GI motility	Abdominal pain, oral burning sensations, gastroesophageal reflux	May be useful to investigate other meal components that may trigger symptoms rather than hot spices on their own merit
Probiotics	Multi-factorial but not clearly defined	Unlikely to produce IBS symptom benefits	Continue at recommended dose if symptom benefits experienced, although long-term effects uncertain
Sweeteners	Poorly absorbed by the gut	May cause laxative effects if consumed in large amounts	Monitor symptoms and adjust intake accordingly

with milder symptoms particularly when delivered by a skilled dietitian as part of a structured and individualised care plan.

3.2 The low-FODMAP diet

FODMAPs are a group of poorly absorbed carbohydrates that can contribute to the symptoms of IBS. These compounds vary in chain length, with short-chain FODMAPs (lactose, fructose, polyols) being rapidly and incompletely absorbed in the small intestine, where they exert osmotic effects that draw water into the bowel, potentially leading to diarrhoea and bloating. In contrast, long-chain FODMAPs (oligosaccharides) are not absorbed in the small bowel and instead reach the colon intact, where they undergo fermentation by colonic bacteria, producing gas and leading to symptoms such as bloating, flatulence, abdominal pain, and altered bowel habits [42–44]. These mechanisms are further detailed in Table 2.

The dietitian-led LFD is recognised as the only recommended second-line treatment for managing IBS when initial dietary interventions are insufficient [40]. This evidence-based approach is designed to alleviate IBS symptoms by reducing the intake of fermentable carbohydrates that are poorly absorbed in the gut and is implemented in three distinct phases – restriction, re-introduction, and personalisation – each playing a crucial role in identifying and managing food triggers specific to the individual [42]. As summarised in Figure 1, these phases are structured to gradually ease IBS symptoms while ensuring long-term dietary sustainability.

The initial restriction phase concerns the global restriction of high-FODMAP food sources for 4–8 weeks with the substitution of suitable low-FODMAP sources to ensure nutritional adequacy. This serves as a diagnostic test for FODMAP sensitivity with a 50–80% positive symptom response. If the patient is non-FODMAP sensitive, alternative dietary interventions are trialled. The second phase reintroduces single FODMAPs over 6–12 weeks in gradually increasing doses over 3 days while the background diet remains low in FODMAPs. Specific challenges include single food containing fructans (wheat-containing bread and garlic), galactans (lentils, legumes), lactose (milk, yoghurt), fructose (honey), sorbitol (dried apricot), and mannitol (mushrooms). This phase is fundamental to prevent unnecessary dietary restrictions and malnutrition in the long term as it determines individual tolerance to specific FODMAPs [45]. In the final phase, the less restrictive personalised diet is formed for the longer term which incorporates low-FODMAP sources and tolerated higher FODMAP sources. However, dietary sources that were not well tolerated should still be re-challenged over time as symptoms may change. It is proposed that a daily threshold of 12 g reduction in dietary FODMAPs results in symptom improvements, keeping in mind individual variability [44,46–51].

Commonly consumed food, including wheat-based bread, pasta and pastries, certain fruits (such as apples and stone fruits), vegetables (such as onion, garlic, and cauliflower), legumes, pulses, and dairy are significantly restricted in the first phase. This may compromise

Table 2: Mechanisms of FODMAP subgroups: IBS symptoms and examples of dietary sources [42–44]

FODMAP subgroup	Mechanism	IBS symptoms	Examples of dietary sources
Monosaccharide – fructose	As a short-chain FODMAP, it is poorly absorbed in the small bowel, exerting osmotic effects by drawing water into the lumen triggering symptoms	Luminal distension contributes to pain and bloating; Diarrhoea on excessive consumption	Apples, pears, watermelon, mango, sugar snap peas, honey, high fructose corn syrup
Disaccharide – lactose	Short-chain FODMAP that requires lactase for digestion. In its absence, lactose is poorly absorbed in the small bowel, exerting osmotic effects	Bloating, abdominal pain, excessive flatus	Milk and products thereof
Oligosaccharides – fructans and galacto-oligosaccharides	Long-chain FODMAPs that bypass the small bowel intact and undergo fermentation by colonic bacteria in the large bowel triggering symptoms	Bloating, abdominal pain, excessive flatus	Wheat and rye and products thereof, legumes, nuts, artichokes, onion, and garlic.
Polyols – mannitol and sorbitol	Short-chain sugar alcohols that are poorly absorbed in the small bowel exerting osmotic effects. Undigested polyols may reach the large bowel, undergoing partial fermentation	Luminal distension	Apples, pears, stone fruits, mushrooms, cauliflower, snow peas, sugar-free products

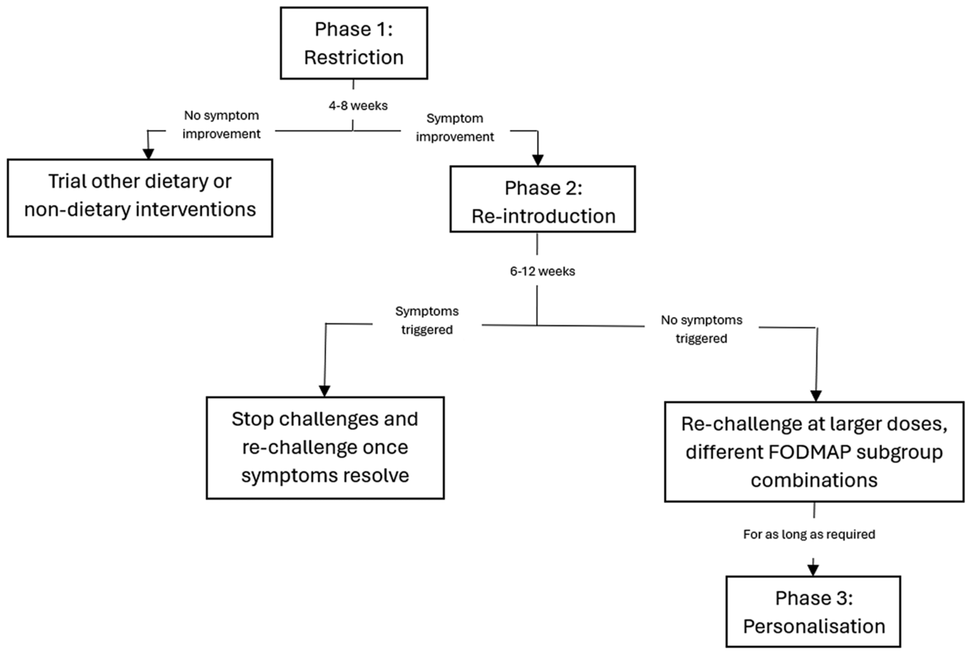

Figure 1: The three phases of the LFD.

nutritional adequacy, as limiting these foods can reduce the intake of key nutrients – calcium from dairy, iron and B vitamins from fortified cereals, and fibre from grains, fruits, vegetables, legumes, and pulses, with several studies looking at adherence to an LFD reporting suboptimal intakes for calcium, iron, magnesium, and B vitamins [5,40,46]. Others have reported a reduced diet quality but not lower nutrient intake [46,51] and reduced energy intakes despite unaffected protein and fat intakes [8]. Oligosaccharide restriction was also attributed to a 4 g/day dietary fibre reduction [40].

A greater symptom improvement is noted with the LFD [55]; however, such an effect may not always be consistent [13,52]. One RCT reported that those following the LFD consumed significantly less energy, carbohydrates, and fibre compared to those following TDA [13,51]. Nevertheless, both the LFD and TDA result in reduced intakes of energy, especially that derived from carbohydrates. After adjusting for the percentage of overall intakes, micronutrient consumption seemed sufficient except for riboflavin [51].

To maintain nutritional adequacy, individuals with IBS are encouraged to follow national dietary recommendations for key nutrients and food groups while incorporating suitable low-FODMAP alternatives. Dietitian-led restriction and personalisation phases of the LFD have been proposed to support overall nutrient intakes. Regular monitoring of body weight is essential and supplementation should be considered for those at risk of nutrient deficiencies [53–56].

The LFD currently represents the most extensively researched dietary intervention for IBS, with multiple systematic reviews and meta-analyses confirming its effectiveness in managing GI symptoms [57–64]. Evidence consistently demonstrates that the LFD significantly improves global IBS symptoms, with particularly pronounced benefits in individuals with diarrhoea-predominant IBS [62,65–69]. Its efficacy is further enhanced when implemented under the guidance of a dietitian, who plays a vital role in ensuring nutritional adequacy throughout the three-phased LFD [61,66,70–72]. Despite its high short-term efficacy, concerns persist regarding the potential long-term consequences of the diet, especially its impact on gut microbiota composition and metabolic outcomes [59,64,65,68]. Current literature underscores the need for further large-scale, high-quality RCTs to determine their long-term safety and sustainability, to assess their relative effectiveness compared to other dietary, supplemental, or lifestyle-based interventions, and to better characterise patient predictors of response, particularly during the personalised re-introduction phase [59,68,72–74].

While the LFD has shown considerable effectiveness in alleviating IBS symptoms, it is not without some limitations. The diet's complexity requires extensive food knowledge and label reading, making adherence challenging, especially in social settings [51,53]. Another key concern is the potential impact on gut health, as some FODMAPs act as prebiotics, supporting the growth of beneficial bacteria in the gut, such as Bifidobacteria and Lactobacilli. Prolonged restriction of these fermentable carbohydrates may inadvertently reduce microbial diversity and alter luminal microbiota composition. Furthermore, although one recent systematic review and meta-analysis reports positive improvements of the LFD on microbial regulation, it highlights the need for further high-quality research to confirm these findings within IBS populations [75]. Moreover, while the fermentation of carbohydrates produces short-chain fatty acids, important for colonic health, this process also results in the release of colonic gas further exacerbating GI symptoms [51,53]. Strategies to combat these concerns such as the re-introduction phase, probiotic supplementation, and dietary personalisation may prove fundamental to minimising the effects that the LFD may exert on the microbiome in the longer term. However, further research is warranted to fully comprehend the complex relationship between diet, IBS symptom profiles, and the gut microbiome [76].

To address these challenges, adapted versions of the LFD have been proposed such as the FODMAP gentle approach. These involve a “bottom-up” approach, where only a few specific FODMAP sources are restricted based on a thorough evaluation of dietary history and symptomatology, rather than adopting a blanket restriction of all FODMAP groups [13,51,77–79]. Furthermore, potential microbiota alterations during the restrictive phases of the diet may be reversed in the final re-introduction phase or supported through probiotic supplementation. However, despite these strategies, evidence about the long-term impact of the complete three-phased LFD remains limited and warrants further research.

3.3 Gluten-free diet (GFD)

Wheat contains components such as fructans, gluten, amylose trypsin inhibitors, and other proteins, which may trigger food intolerance symptoms in 23–49% of IBS sufferers, with studies reporting a 58% clinical response to a GFD [13]. The physiologic mechanism of wheat-based fructans is explained in Table 2. Gluten has been primarily associated with symptoms such as abdominal pain, bloating, altered stool consistency, increased gut permeability, immune activation, and fatigue, suggesting that it may be a key driver of symptom onset following wheat consumption [48,80,81]. Supporting this, several studies have reported a reduction in overall symptom severity, including bloating and abdominal pain, in IBS patients following a GFD [82–85].

Nevertheless, the GFD raises dietary concerns including increased fat intake and reduced carbohydrate and fibre intake, along with observed deficiencies in iron, calcium, thiamine, and magnesium. However, data about the nutritional adequacy of GFD in IBS are rather limited [13].

Evidence supporting a GFD for IBS is still lacking predominantly due to the fact that symptom alleviation may not be solely due to gluten exclusion as a GFD also eliminates fructans [13,40,47]. In a placebo-controlled, crossover rechallenge study, patients habitually consuming a GFD in view of non-coeliac gluten sensitivity experienced symptom improvement with an LFD. No independent gluten-specific effects were noted on gluten challenges concluding that FODMAPs are responsible for GI symptoms and not gluten [86]. Moreover, no further benefits were observed when a GFD was introduced to IBS patients already following an LFD [7].

Eliminating consumption of cereals reduces dietary FODMAP content by 50% and may alleviate symptoms [13,40]. Single food challenges are warranted to determine whether such food products trigger symptoms. It remains unclear whether gluten is responsible for IBS symptoms while evidence for fructans as a predominant symptom trigger is accumulating [40]. However, one observational study also reports no correlation between GI symptoms

Table 3: Dietary sources allowed and prohibited in the SCD (adapted from [87])

Food category	Food allowed in the SCD	Food prohibited in the SCD
Fruit	Any fresh fruit	Any canned fruit with added sugar or ingredients, juices
Vegetables	Any fresh vegetables (except for potatoes and corn)	Potatoes, corn, any canned vegetables with added sugar or ingredients
Dairy	Homemade prebiotic yoghurt, goat cheese	Most dairy (milk, cheese, most yoghurt, ice cream)
Meat, fish, and poultry	Chicken, turkey, meat, game, fish, eggs	Processed meats
Cereals	None	All
Legumes	Beans, lentils, peas	Soy, chickpea, broad bean
Nuts	All	None
Spices	All	None
Sweeteners	Honey	Sugar and other sweeteners

and fructan intake [15]. Further research is warranted to determine the long-term efficacy of a GFD for IBS as most RCTs are short term [13].

3.4 Specific carbohydrate diet (SCD)

The SCD allows only monosaccharide carbohydrates while excluding disaccharides and polysaccharides. It is supplemented with homemade yoghurt fermented for 24 h to minimise the disaccharide lactose. This diet, including a number of allowed and prohibited foods as outlined in Table 3, is proposed as it may reduce inflammation and microbiota dysfunction [87].

As can be determined from Table 3, the SCD shares overlapping mechanisms with the LFD particularly in its exclusion of disaccharides in the form of lactose (found in dairy) and polysaccharides such as starch (found in cereal, potatoes, corn), which are known to be osmotic and fermentable, leading to gas production, bloating and discomfort in IBS patients. Therefore, both diets aim to alleviate IBS symptoms by reducing fermentable carbohydrate intake, but while the LFD takes a broader approach by excluding additional FODMAPs including oligosaccharides and polyols, the SCD is more focused on limiting specific complex carbohydrates. Indeed, a recent randomised non-inferiority study reported that a diet low in starch and sugar shares similar efficacy with the LFD in the reduction of GI symptoms, possibly due to the overlap between the two dietary patterns [88].

Contrastingly, a clinical single-blinded RCT noted that the LFD provided significant improvements in bloating and distension compared to the SCD. Folic acid and vitamin D deficiencies were also observed with the SCD [87]. Such findings support those previously reported in the literature [5]. Given the absence of significant improvements in symptoms, such an exclusion diet is not routinely recommended [40].

3.5 Low lactose or lactose-free diet

Lactose intolerance is common in both the general population and amongst IBS sufferers. Symptoms are triggered due to the inability to form lactase enzymes, unfavourable microbiota compositions, or history of GI disorders. Not all lactose malabsorbers experience symptoms following consumption while symptoms may be heightened at even minimal intakes with visceral hypersensitivity [50]. One systematic review reports the absence of any clear correlations between IBS and lactose intolerance and does not support routine lactose-free diets for all IBS sufferers. Further research is warranted to determine whether any specific components in dairy other than lactose are responsible for IBS complaints [89]. In light of the available evidence, low lactose or lactose-free diets for the management of IBS symptoms should be considered as part of an LFD and not on their own merit.

3.6 Low fructose diet

Over one in three adult IBS sufferers experience fructose malabsorption and its prevalence is similar amongst IBS sufferers and asymptomatic controls [50,90]. The main determinants of fructose malabsorption are presumed to be excessive fructose intake, co-ingestion of fructose and sorbitol, and fructose in excess of glucose as when fructose and glucose are equimolarly ingested, symptomatic improvements were recorded [50,90,91]. Fructose is present in equimolar amounts to glucose in bananas, strawberries, table sugar, and high-fructose corn syrup [91]. Nevertheless, a low fructose diet is rarely acknowledged as effective since fructose malabsorption is a separate disease from and not specific to IBS; it may be uncommon and due to the absence of published dietary guidelines [90]. Should a low fructose diet be warranted for the management of IBS symptoms, this should be considered part of the LFD.

3.7 Comparative analysis

A lack of consensus exists with regard to the comparative efficiency of TDA, LFD, and GFD and it remains unclear which dietary treatment is superior due to the absence of head-to-head trials. RCTs demonstrate similar efficiency between these diets with TDA appearing to be less costly and time consuming and easier to comply with [52,92]. The key uses and limitations of the dietary interventions analysed in this narrative review are compared in Table 4. Table 4 may serve as a practical resource for healthcare professionals guiding decisions as to the most appropriate dietary intervention to adopt.

3.8 Emerging dietary trends

With advancements in IBS care, novel dietary interventions show promise for symptom relief. Precision nutrition has the potential to revolutionise GI health by tailoring dietary interventions based on individual gut microbiota profiles offering promising approaches for the management of IBS symptoms [16]. One pilot clinical study compared microbiota compositions of mixed subtypes of IBS patients, as diagnosed by the Rome IV criteria, against that of a control group. Following 6 weeks of either AI-based personalised nutrition or a standard IBS diet, it was concluded that AI-based personalised microbiome modulation through diet improved IBS symptoms and induced favourable microbiome changes, but further large-scale RCTs with long-term follow-up are necessary [17]. A multicentre RCT comparing the effectiveness of microbiome-based AI-assisted personalised diets against the LFD for IBS symptom management concluded that the AI-assisted personalised diet approach demonstrates significant symptom improvements, improved quality of life, and enhanced microbiome diversity [18].

In their hypothesis-driven article, Black and Ford propose a novel framework for the management of IBS that moves beyond traditional symptom-based subtyping. Using latent class analysis, seven distinct patient clusters were identified and characterised by unique constellations of GI symptoms, extraintestinal manifestations, and psychological comorbidities. This classification model demonstrated predictive value for healthcare utilisation, treatment response and quality of life outcomes. By outlining tailored first- and second-line treatment strategies for each cluster, the authors offer a personalised, mechanistically informed approach to IBS care. This model underscores the heterogeneity of IBS and presents a compelling argument for shifting towards stratified treatment pathways, warranting validation through prospective clinical trials [95]. Further three studies support the integration of precision nutrition in IBS care while encouraging future long-term and larger-scale RCTs to fully determine the effectiveness of such digital and personalised dietary interventions [96–98]. As our understanding of the genetic underpinnings of IBS and nutrient interactions expands, precision nutrition may become a cornerstone in the comprehensive management of this complex disorder.

Table 4: Comparative analysis of the key uses and limitations of dietary interventions for the management of IBS symptoms

Dietary approach	Key uses	Limitations
TDA	Less costly and time consuming and easier compliance compared to alternative dietary interventions. Best suited for those with limited cooking and literacy skills to read food labels and for those with more hectic lifestyles Deemed more acceptable and thus recommended as the first-line option [13,40]	Some may require a stricter approach in view of a greater level of food sensitivity and intolerance [13,93]
LFD	Better suited for those who require a stricter approach [13,93] Suitable for those who have minimal knowledge of what food sources or groups trigger symptoms as the three-phased diet enables the determination of FODMAP sensitivity and tolerance to different FODMAP subgroups	Limited long-term implications data May be contraindicated for those with a history of eating disorders, those at risk of malnutrition and paediatric and geriatric populations Barriers to implement include reliance on ready-made or processed food, frequently disordered eating patterns, limited cooking skills, or control over food preparation and cooking at one's own household
FODMAP gentle approach	Suitable for patients with milder IBS symptoms or who consume high FODMAP loads, geriatric and paediatric populations, patients who may be overwhelmed by the full LFD such as those with a history of eating disorders or have low cooking skills [94]	May not identify exclusive FODMAP symptom triggers Absence of robust trial evidence [94]
GFD	Suitable "bottom-up approach" for those who identify gluten as a predominant trigger [13]	Supporting evidence is still lacking predominantly since symptom alleviation may not be solely due to gluten exclusion but due to fructan elimination [7,80,86]
SCD	Proposed as it may reduce inflammation and microbiota dysfunction [87]	Not routinely practised due to absence of significant improvements [40]
Low lactose/ lactose-free diet	High lactose sensitivity, as may be determined through a three-phased dietetic-led LFD [40]	Absence of any clear correlations between IBS and lactose intolerance warranting further research. Routine lactose-free diets are not recommended to all IBS sufferers [89]
Low fructose diet	Fructose sensitivity, as may be determined through a three-phased dietetic-led LFD [40]	Rarely acknowledged as an effective dietary intervention for IBS [90]

The role of PBDs in managing IBS symptoms has garnered increasing attention, although the existing evidence remains preliminary and warrants further investigation. PBDs may confer GI benefits through the increase in gut bacterial diversity [19–21]. One cross-sectional study investigating the association between PBDs and IBS in a large French cohort concluded that long-term PBDs may be associated with IBS but further long-term studies are necessary to confirm this association [22]. Additionally, one systematic review and meta-analysis suggests that PBDs may influence the circulating levels of inflammatory markers and reports a strong association between c-reactive protein, an inflammatory marker, and PBDs. Nevertheless, further investigation is necessary [23]. While PBDs are generally considered beneficial for gut health, some individuals with IBS may experience symptom exacerbation due to increased fibre intake, particularly from high-FODMAP plant foods. Therefore, personalised dietary approaches, possibly integrating elements of PBDs with low-FODMAP principles, may offer a balanced strategy for managing IBS symptoms.

The MD characterised by high consumption of fruits, vegetables, wholegrains, legumes, nuts, seeds, olive oil, and moderate intake of fish and poultry has garnered attention for its potential benefits in managing IBS symptoms. A recent pilot RCT concluded that the MD improves abdominal symptoms for diarrhoea-predominant IBS and mixed subtypes IBS but warrants larger-scale trials to evaluate the effectiveness of the MD against that of LFD and TDA [28]. In agreement, a 6-week RCT involving adults with Rome IV-diagnosed IBS demonstrated that participants adhering to the MD experienced significant reductions in GI and depressive symptoms compared to controls [27]. Similarly, a network meta-analysis identified the MD as one of the most effective dietary interventions for improving IBS symptom severity and quality of life. Nevertheless, it still warrants future large-scale RCTs with head-to-head comparisons to fully comprehend the effectiveness of the MD for IBS populations [29]. These findings are supported by studies indicating that the anti-inflammatory properties of the MD, attributed to components like polyphenols and omega-3 fatty acids, may modulate gut microbiota composition, potentially enhancing gut health and immune function as well as reducing inflammation in IBS patients [24–27]. Ultimately, while currently available evidence supports the efficacy and feasibility of the MD in IBS symptom management, a combined LFD and MD, or an IBS-modified MD, is recommended for further study and to establish clinical guidelines [99].

The current evidence on IF as a dietary intervention for managing IBS remains preliminary and inconclusive. IF may offer therapeutic benefits through gut microbiota modulation [30,31]. A systematic review of human studies on IF and gut microbiota found that IF can improve gut microbiota richness and alpha diversity which may potentially offer beneficial effects for IBS patients. However, this systematic review highlights the need for further research to clarify and confirm such effects in light of the substantial heterogeneity in results and bacterial strains determined to be statistically significantly influenced by this dietary pattern [30]. While IF shows promise in modulating factors associated with IBS, its clinical application remains uncertain and more rigorous, long-term studies are needed to determine its efficacy and safety in IBS management.

The role of histamine in IBS has garnered increasing attention in recent years, particularly in relation to the emerging concept of histamine intolerance [100]. Although the pathophysiology of IBS is multifactorial, evidence suggests that histamine has the potential to influence gut motility, visceral hypersensitivity, and intestinal inflammation triggering symptoms [101–103]. A positive correlation is identified between mast cells, which release histamine, and IBS symptoms particularly abdominal pain and bloating [104]. Accepted dietary guidelines for a low histamine diet are yet not available, but generally, a low histamine diet involves an elimination-type diet reducing the consumption of hard and semi-hard cheeses, oily fish and shellfish, raw fermented meat products, chicken eggs, fermented soy products, pickled vegetables, fruit and vegetables triggering the release of endogenous histamine, mushrooms, chocolate, wine and beer [103]. However, the role of histamine in IBS is not fully elucidated and the current body of evidence remains limited making it difficult to establish clear clinical guidelines [105]. As such, while a low histamine diet may offer therapeutic potential for certain IBS subtypes, its routine use in clinical practice warrants further investigation supported by high-quality research.

The ketogenic diet, characterised by high fat, adequate protein, and very low carbohydrate intake, has been explored for its therapeutic potential beyond epilepsy and weight management, including in GI disorders such as IBS. The proposed mechanisms through which a ketogenic diet may benefit IBS include modulation of the gut microbiota due to ketone body activity [106–108]. However, the current evidence supporting its efficacy in IBS remains sparse and largely preclinical. Most available studies have been conducted in animal models, particularly rats, demonstrating beneficial changes in gut permeability, inflammation, and microbial composition [106,109]. A limited number of human case studies have suggested that very low carbohydrate diets may reduce symptoms such as bloating, abdominal pain, and altered bowel habits, especially in individuals with diarrhoea-predominant IBS [110]. Moreover, concerns regarding the diet's restrictiveness, potential nutritional deficiencies, and its impact on gut microbial diversity raise questions about its safety and sustainability for IBS management [108]. While the ketogenic diet may offer symptomatic relief for select patients, there is insufficient high-quality evidence to support its widespread use in IBS treatment and further RCTs are needed to clarify its role.

3.9 Dietary intake of international IBS populations

Nutrient intakes of IBS populations differ across geographical regions with some studies agreeing that IBS does not adversely affect nutrient intakes. A recent systematic review and meta-analysis reports no significant differences in dietary intake between IBS and non-IBS sufferers except for suboptimal intakes of fibre, calcium, and vitamin D [32]. Additionally, a cross-sectional study targeting an English population reported a low risk of nutritional deficiencies and stated that adequate substitutions and supplementation were being practised if specific foods were being excluded [33]. In agreement, a Swedish study reported no significant differences between the dietary intake of IBS and non-IBS sufferers with IBS participants consuming higher dietary fibre intakes compared to the general population. The only suboptimal intakes observed were those for vitamin A, riboflavin, calcium, and potassium mainly due to limited intakes of dairy [34]. An additional RCT also reports nutrient intakes comparable to the general population and even suggests that the LFD may improve overall dietary intake. Vitamin B12 was higher compared to habitual diets, possibly due to increased intakes of eggs and fish [35]. Furthermore, a North American study concluded that IBS sufferers consume significantly higher energy intakes compared to non-IBS counterparts [111].

However, the following studies contraindicate this by arguing that IBS sufferers practise significantly more dietary avoidances. A study performed in a large French population concluded that IBS sufferers consume less milk, yoghurt, and fruits and greater intakes of non-sugar-sweetened beverages [36]. A Norwegian study also reports dairy avoidance in view of lactose malabsorption and intolerance with calcium, potassium, zinc, and B vitamins deficiencies as a consequence [37]. Both studies report a limited consumption of fruit and vegetables due to their potential to generate gas upon fermentation and laxative effects further depleting levels of water-soluble vitamins and minerals. Higher intakes of water and carbonated beverages might be observed in an attempt to compensate for fluids lost through diarrhoea or to prevent constipation. Tea may be avoided as salicylate content may cause constipation and gut symptoms while coffee is related to diarrhoea. A higher intake of carbonated beverages may worsen symptoms due to the potential presence of caffeine. Alternatively, it may be consumed in addition to water with the aim of substituting milk with other fluids to meet fluid requirements as recommended for the management of constipation and diarrhoea. Although alcohol is known to exacerbate symptoms, its consumption may persist in an attempt to relieve severe symptoms [36,37]. Vitamin D levels may also be depleted through the avoidance of fortified dairy [38].

Cultural diets, food availability, and strength of healthcare systems play significant roles in shaping dietary intake and adherence to dietary interventions among IBS populations. Cultural dietary patterns, including staple foods, preparation methods, and meal structures vary widely across regions and often influence the types of food consumed by individuals with IBS. For instance, in regions where high-fibre foods are common, such as in Mediterranean or East Asian diets, IBS patients may experience different symptom management outcomes compared to those in regions with lower fibre intake or a reliance on processed foods such as the Western diet. Moreover, access to food may hinder the IBS patients' ability to follow specialised diets, such as the LFD or GFD, which may be difficult to adhere to without access to specific food or ingredients. The health system also plays a critical role in IBS management, as its effectiveness in providing education and access to the relevant healthcare professionals, especially dietitians, influences adherence to dietary recommendations. In countries with well-established healthcare infrastructures, IBS patients may have better access to tailored dietary counselling, while in regions with less comprehensive healthcare systems, patients may face challenges in obtaining the necessary support to manage their condition effectively. These factors collectively contribute to variations in nutritional profiles and symptomatology, as cultural, economic, and healthcare-related barriers impact both the quality of the diet and the ability to adhere to tailored dietary interventions.

Table 5 summarises dietary findings of IBS sufferers from different geographical regions and may serve as a useful practical clinical tool for healthcare professionals as it provides an outline of possible dietary deficiencies. It also serves as a valuable resource for improving patient care and facilitating tailored management strategies.

Table 5: Studies reporting key dietary findings of IBS sufferers from different geographical regions using alternative dietary data tools

Author	Year	Setting	Study design	No of subjects in study sample	Dietary data tools	Key findings
Malhotra and Olver [112]	2004	Northern India	Cross-sectional study	33	72-h dietary recall	IBS patients consumed lower macronutrient and fibre intake compared to healthy controls
Monsbakken et al. [113]	2005	Norway	Cross-sectional study	84	Interview with dietitian	70% prevalence of food intolerance in IBS subjects
McCoubrey et al. [114]	2008	UK	Cross-sectional study	51	FFQ	Similar energy and macronutrient intakes found for IBS sufferers and controls. However, calcium and iron intakes were significantly lower in IBS sufferers compared to controls
Singh et al. [115]	2008	India	Cross-sectional study	81	Semi-quantitative FFQ	Similar dietary fibre intakes between IBS sufferers and healthy controls. Dietary fibre intake for both groups exceeded national recommendations
Prescha et al. [116]	2009	Poland	Cross-sectional study	63	24-h dietary recall	IBS sufferers consumed insufficient energy intakes from carbohydrates and insufficient intakes of calcium and vitamin B2 compared to Polish RDAs. Overconsumption of fat and saturated fatty acids was also observed
Østgaard et al. [117]	2011	Norway	Cross-sectional study	114	FFQ	No statistical difference in the intake of energy, carbohydrates, fat, and protein between IBS subjects and controls
Williams et al. [33]	2011	UK	Cross-sectional study	104	Modified version of the EPIC FFQ	IBS participants consumed higher energy, protein, NSP, and micronutrients intake and lower fat and carbohydrate when compared to the UK DRVs IBS participants consumed higher energy, carbohydrate, protein, and micronutrient intakes and lower energy derived from fat when compared to a National Diet and Nutrition Survey
Böhn et al. [34]	2012	Sweden	Cross-sectional study	187	4-day FD	Nutrient intake of IBS sufferers appears to be adequate when compared to Nordic Nutrition Recommendations and similar to that of the general population
Ligaarden et al. [37]	2012	Norway	Cross-sectional study	388	FFQ	Subjects with IBS consumed lower intakes of dairy products and potatoes but higher intakes of water, tea, and carbonated beverages compared to subjects without IBS
Staudacher et al. [77]	2012	UK	RCT	41	7-day FD	Restriction of fermentable short-chain carbohydrates resulted in reductions in overall symptoms and bloating compared to habitual diets. Lower intakes of total carbohydrates, starch, total sugars, and calcium noted when following the diet restricted in fermentable short-chain carbohydrates
Omagari et al. [118]	2013	Japan	Cross-sectional study	245	Semi-quantitative FFQ	Mean daily intakes of energy, carbohydrates, fibre, calcium, and iron were lower while intakes of protein and salt were higher compared to the Dietary Reference Intakes for Japanese

(*Continued*)

Table 5: *Continued*

Author	Year	Setting	Study design	No of subjects in study sample	Dietary data tools	Key findings
Böhn et al. [52]	2015	Sweden	Multi-centre, parallel, randomised, controlled, single-blinded, comparative trial	67	4-day FD	LFD did not appear to be superior to TDA as both improved IBS symptoms. A lower energy intake was observed in both dietary interventions
Zahedi et al. [93]	2016	Iran	RCT, single blind	101	3-day FD	Lower energy intake in both LFD and TDA
Tigchelaar et al. [119]	2017	Netherlands	Cross-sectional, case-control study	380	FFQ	IBS cohort consumed higher intakes of fat and sugar while lower intakes of fibre compared to healthy controls
Vincenzi et al. [87]	2017	Italy	Clinical, single-blinded randomised trial	60	FD	Patients suffering from IBS seem to benefit from an LFD but not from an SCD LFD does not appear to cause vitamin D and folic acid deficiencies compared to SCD
Torres et al. [36]	2018	France	Cross-sectional study	36,448	24-h dietary records	IBS subjects had significantly lower intakes of milk, yoghurt, and fruits but higher intakes of non-sugary drinks compared to controls IBS subjects had higher total energy intake with a slightly higher percentage derived from fat and a lower percentage derived from protein compared to controls. Percentage of energy from carbohydrates did not differ between groups but IBS subjects tended to reach the RDA for fibre more than healthy controls IBS subjects consumed lower intakes of calcium, potassium, zinc, and vitamins B2, B5 and B9 compared to controls
Alharbi et al. [120]	2019	Northern Saudi Arabia	Cross-sectional survey	930	Purposeful questionnaire	IBS is significantly associated with insufficient fluid and fibre intake. Spicy food consumption is directly associated with IBS
Nilholm et al. [121]	2019	Sweden	Randomised open clinical trial	105	5-day FD	IBS patients consumed irregular dietary habits with excessive intakes of fast and processed food, cereals, sweets, and sugar-sweetened beverages and low intakes of fish, vegetables, legumes, fruits, berries, and dairy products. Overall dietary intakes did not follow the recommendations of a healthy Nordic diet
Staudacher et al. [35]	2019	UK	RCT	130	7-day FD	Resultant nutrient intakes of IBS sufferers did not meet respective DRVs. However, overall dietary intake was comparable to the general population
Yilmaz and Akbulut [122]	2019	Turkey	Cross-sectional study	70	3-day FD + FFQ	IBS participants consumed energy and macronutrient intakes similar to the general Turkish population. However, low intakes of vitamins B9 and 12, potassium, calcium, and magnesium were noted in the majority of IBS participants

(*Continued*)

Table 5: *Continued*

Author	Year	Setting	Study design	No of subjects in study sample	Dietary data tools	Key findings
Hujoel [111]	2020	USA	Cross-sectional study	413	24-h dietary recall + FFQ	Despite IBS sufferers reporting significantly more food avoidances, similar macro- and micronutrient intakes were observed between IBS sufferers and controls
Shafiee et al. [123]	2022	Malaysia	Retrospective case–control study	306	FFQ	IBS patients experiencing predominantly constipation consumed significantly lower intakes of wholegrain products, fried foods, dairy products, fruits, and vegetables compared to healthy controls. Daily intakes of energy, certain macronutrients, and micronutrients among IBS-C patients was significantly lower than the healthy subjects. Dietary intake of fibre, vitamins B_1, B_2, B_6, folate, B_{12}, E, and K, and potassium was below the standard RNI
Khoo et al. [69]	2023	Malaysia	Multi-centre study	29	3-day FD	LFD improves the quality of life and symptoms in IBS sufferers
Hillestad et al. [72]	2024	Norway	Prospective single-arm intervention study	36	3-day FD	No clinically meaningful changes found in macronutrient and micronutrient intake following a 12-week dietitian-led LFD. However, low diet quality was identified in IBS sufferers prior intervention
Alrasheedi et al. [61]	2025	Saudi Arabia	Prospective single-arm intervention study	45	Semi-quantitative FFQ	LFD results in significant symptom benefits but may result in nutritional deficiencies and malnutrition if not supplemented with adequate low-FODMAP options

IBS = irritable bowel syndrome, FFQ = food frequency questionnaire, RDA = recommended dietary allowances, NSP = non-starch polysaccharides, DRVs = Dieta45ry reference values, FD = food diary, RCT = randomised controlled trial, LFD = low-FODMAP diet, TDA = traditional dietary advice, SCD = specific carbohydrate diet, IBS-C = irritable bowel syndrome-constipation predominant, RNI = reference nutrient intake, FODMAP = fermentable oligosaccharides, disaccharides, monosaccharides and polyols.

4 Strengths and limitations

This review has highlighted the importance of individualised dietary interventions emphasising the potential benefits of dietary strategies, such as TDA, LFD, and GFD. Despite extensive research, the complexity of IBS and inter-patient variability continues to challenge a clear understanding while still advocating for individually tailored dietary interventions. Although this review was not conducted systematically, it provides a comprehensive overview of dietary interventions for IBS, supported by a rigorous search strategy that minimises selection bias.

Nevertheless, several limitations warrant consideration. A comprehensive understanding of the role of diet in managing IBS symptoms remains complex, primarily due to factors such as small sample sizes, the absence of blinding which may contribute to placebo and nocebo effects and the inherent variability in individual responses. Additionally, the heterogeneity of IBS symptomatology and diagnostic criteria further complicates the interpretation of findings, limiting the ability to draw definitive conclusions.

The discrepancies and similarities in dietary intake among IBS populations across different geographical regions may be attributed to a range of factors. Variations in nutritional assessment methods, such as the use of food frequency questionnaires, 24-h dietary recalls, or food diaries, may influence the accuracy and comparability of data. Sample size and demographic differences, including age, gender, cultural dietary patterns, and healthcare access, also contribute to heterogenous findings. Furthermore, variability in the diagnostic criteria used to define IBS, such as Rome III versus Rome IV, may affect the population characteristics being studied. In some scenarios, the presence of dietitian support or national dietary guidance may promote more balanced substitutions and reduce the risk of deficiencies. Lastly, publication year and local food availability can also shape dietary trends and nutrient intake outcomes. These methodological and contextual differences highlight the need for standardised, cross-national research to better understand and compare the nutritional impact of IBS globally.

5 Conclusion

Diet plays a crucial role in the holistic management of IBS, however, current evidence does not yet support one universally superior dietary intervention. As such, personalised and symptom-targeted dietary strategies remain the cornerstone of effective care. A multidisciplinary approach, led by a qualified dietitian, is essential to guide this process and prevent overly restrictive eating patterns. Keeping a detailed food and symptom diary can assist in identifying potential dietary triggers, reducing the risk of unnecessary exclusions. When symptom patterns are unclear, second-line approaches such as the LFD may be trailed short-term under dietetic supervision. Given the multifactorial nature of IBS, individualised, patient-centred advice continues to be the most appropriate strategy in clinical practice.

Further research is needed to compare dietary interventions and investigate their long-term effects. The LFD shows promise, with evidence suggesting that many individuals may sustain symptom relief with minimal restrictions over time. However, more studies are required to confirm its long-term safety and efficacy. Additionally, a greater understanding is required regarding the role of different fibre types in IBS management. Exploring personalised diets based on genetic, gut microbiome, and metabolic profiles could further refine dietary strategies, enhancing both compliance and therapeutic outcomes. Standardised protocols for dietary interventions would enable healthcare professionals, particularly dietitians, to deliver more effective, individualised care.

Cross-national studies identifying IBS populations with suboptimal dietary intakes are crucial to addressing potential nutrient deficiencies and improving national dietary recommendations. This review underscores the often-overlooked role of cultural influences on dietary patterns in IBS management, which significantly impacts nutritional status and treatment outcomes. Moreover, Table 5 in this narrative review provides a practical clinical tool that healthcare professionals can utilise to guide dietary interventions for IBS patients, offering a valuable resource for improving patient care and tailored management.

Ultimately, while personalised dietary interventions hold great promise, they should be integrated into a holistic treatment approach that accounts for the multifactorial nature of IBS. Combining individualised dietary strategies with pharmacological and psychological therapies can provide a more comprehensive management plan, improving symptom control and enhancing patients' overall quality of life.

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References

[1] Card T, Canavan C, West J. The epidemiology of irritable bowel syndrome. Clin Epidemiol. 2014;6(6):71–80.

[2] Lovell RM, Ford AC. Global prevalence of and risk factors for irritable bowel syndrome: a meta-analysis. Clin Gastroenterol Hepatol. 2012;10(7):712–21.e4.

[3] Oka P, Parr H, Barberio B, Black CJ, Savarino EV, Ford AC. Global prevalence of irritable bowel syndrome according to Rome III or IV criteria: a systematic review and meta-analysis. Lancet Gastroenterol Hepatol. 2020;5(10):908–17.

[4] Sperber AD, Bangdiwala SI, Drossman DA, Ghoshal UC, Simren M, Tack J, et al. Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome foundation global study. Gastroenterology. 2020;160(1):99–114.

[5] Bek S, Teo YN, Tan XH, Fan KHR, Siah KTH. Association between irritable bowel syndrome and micronutrients: A systematic review. J Gastroenterol Hepatol. 2022;37(8):1485–97, https://pubmed.ncbi.nlm.nih.gov/35581170/.

[6] Hayes P, Corish C, O'Mahony E, Quigley EMM. A dietary survey of patients with irritable bowel syndrome. J Hum Nutr Dietetics. 2013;27:36–47, https://onlinelibrary.wiley.com/doi/full/10.1111/jhn.12114.

[7] Lacy BE, Mearin F, Chang L, Chey WD, Lembo AJ, Simren M, et al. Bowel disorders. Gastroenterology. 2016;150(6):1393–407.e5.

[8] Mitchell H, Porter J, Gibson PR, Barrett J, Garg M. Review article: implementation of a diet low in FODMAPs for patients with irritable bowel syndrome-directions for future research. Aliment Pharmacol Ther. 2018;49(2):124–39.

[9] Jones J. British Society of Gastroenterology guidelines for the management of the irritable bowel syndrome. Gut. 2000;47(90002):1ii19.

[10] NICE. Overview | Irritable bowel syndrome in adults: diagnosis and management | Guidance | NICE [Internet]. Nice.org.uk. NICE; 2008. http://www.nice.org.uk/Guidance/CG61.

[11] Zhou S, Liu X, Wang X, Xi F, Luo X, Yao L, et al. Pharmacological and non-pharmacological treatments for irritable bowel syndrome. Medicine. 2019;98(30):e16446.

[12] Black CJ, Thakur ER, Houghton LA, Quigley EM, Moayyedi P, Ford AC. O61 Efficacy of psychological therapies for irritable bowel syndrome: systematic review and network meta-analysis. Oral. 2021;69(8):1441–51.

[13] Rej A, Avery A, Aziz I, Black CJ, Bowyer RK, Buckle RL, et al. Diet and irritable bowel syndrome: an update from a UK consensus meeting. BMC Med. 2022;20(1):287.

[14] Saito YA, Locke GR, Weaver AL, Zinsmeister AR, Talley NJ. Diet and functional gastrointestinal disorders: a population-based case-control study. Am J Gastroenterol. 2005;100(12):2743–8.

[15] Algera JP, Störsrud S, Lindström A, Simrén M, Törnblom H. Gluten and fructan intake and their associations with gastrointestinal symptoms in irritable bowel syndrome: A food diary study. Clin Nutr. 2021;40(10):5365–72.

[16] Ghaffari P, Shoaie S, Nielsen LK. Irritable bowel syndrome and microbiome; Switching from conventional diagnosis and therapies to personalized interventions. J Transl Med. 2022;20(1):173.

[17] Karakan T, Gundogdu A, Alagözlü H, Ekmen N, Ozgul S, Tunali V, et al. Artificial intelligence-based personalized diet: A pilot clinical study for irritable bowel syndrome. Gut Microbes. 2022;14(1):2138672.

[18] Tunali V, Arslan NÇ, Ermiş BH, Hakim GD, Gündoğdu A, Hora M, et al. A Multicenter randomized controlled trial of microbiome-based artificial intelligence-assisted personalized diet vs low-fermentable oligosaccharides, disaccharides, monosaccharides, and polyols diet: a novel approach for the management of irritable bowel syndrome. Am J Gastroenterol. 2024;119(9):1901–12.

[19] Mazzocchi S, Visaggi P, Baroni L. Plant-based diets in gastrointestinal diseases: Which evidence? Best Pract Res Clin Gastroenterol. 2023;62–63:101829.

[20] Tomova A, Bukovsky I, Rembert E, Yonas W, Alwarith J, Barnard ND, et al. The effects of vegetarian and vegan diets on gut microbiota. Front Nutr. 2019;6(47):1–10.

[21] Kim SH, Kang W, Kim M, Hong S, Kim H, Lee JK. Temple stay diet and its impact on gut microbiome and irritable bowel syndrome: a prospective cohort study. Food Funct. 2025;16(12):4894–903

[22] Buscail C, Sabate JM, Bouchoucha M, Torres MJ, Allès B, Hercberg S, et al. Association between self-reported vegetarian diet and the irritable bowel syndrome in the French NutriNet cohort. PLOS ONE. 2017;12(8):e0183039.

[23] Menzel J, Jabakhanji A, Biemann R, Mai K, Abraham K, Weikert C. Systematic review and meta-analysis of the associations of vegan and vegetarian diets with inflammatory biomarkers. Sci Rep. 2020;10(1):21736.

[24] Chen E, Mahurkar-Joshi S, Liu C, Jaffe N, Labus JS, Dong TS, et al. The association between a Mediterranean diet and symptoms of irritable bowel syndrome. Clin Gastroenterol Hepatol. 2023;22(1):164–72.

[25] Kasti A, Petsis K, Lambrinou S, Katsas K, Nikolaki M, Papanikolaou IS, et al. A combination of Mediterranean and low-FODMAP diets for managing IBS symptoms? Ask your gut! Microorganisms. 2022;10(4):751.

[26] Kasti AN, Katsas K, Petsis K, Lambrinou S, Synodinou KD, Kapetani A, et al. Is the Mediterranean low fodmap diet effective in managing irritable bowel syndrome symptoms and gut microbiota? An innovative research protocol. Nutrients. 2024;16(11):1592.

[27] Staudacher HM, Mahoney S, Kim Ek Canale, Opie R, Loughman A, So D, et al. Clinical trial: A Mediterranean diet is feasible and improves gastrointestinal and psychological symptoms in irritable bowel syndrome. Aliment Pharmacol Ther. 2023;59(4):492–503.

[28] Singh P, Dean G, Iram S, Peng W, Chey SW, Rifkin S, et al. Efficacy of Mediterranean diet vs low-FODMAP diet in patients with nonconstipated irritable bowel syndrome: a pilot randomized controlled trial. Neurogastroenterol Motil. 2025;e70060.

[29] Haghbin H, Hasan F, Gangwani MK, Zakirkhodjaev N, Lee-Smith W, Beran A, et al. Efficacy of dietary interventions for

irritable bowel syndrome: a systematic review and network meta-analysis. J Clin Med. 2024;13(24):7531.
[30] Paukkonen I, Törrönen EN, Lok J, Schwab U, El-Nezami H. The impact of intermittent fasting on gut microbiota: a systematic review of human studies. Front Nutr. 2024;11:1342787.
[31] Teker HT, Ceylani T. Intermittent fasting supports the balance of the gut microbiota composition. Int Microbiol. 2022;26(1):51–7.
[32] Veraza DI, Calderon G, Jansson-Knodell C, Aljaras R, Foster ED, Xu H, et al. A systematic review and meta-analysis of diet and nutrient intake in adults with irritable bowel syndrome. Neurogastroenterol Motil. 2023;36(1):e14698.
[33] Williams EA, Nai X, Corfe BM. Dietary intakes in people with irritable bowel syndrome. BMC Gastroenterology. 2011;11(1):1–7.
[34] Böhn L, Störsrud S, Simrén M. Nutrient intake in patients with irritable bowel syndrome compared with the general population. Neurogastroenterol Motil. 2012;25(1):23.e1.
[35] Staudacher HM, Ralph FSE, Irving PM, Whelan K, Lomer MCE. Nutrient intake, diet quality, and diet diversity in irritable bowel syndrome and the impact of the low FODMAP diet. J Acad Nutr Dietetics. 2020;120(4):535–47.
[36] Torres MJ, Sabate JM, Bouchoucha M, Buscail C, Hercberg S, Julia C. Food consumption and dietary intakes in 36,448 adults and their association with irritable bowel syndrome: Nutrinet-Santé study. Ther Adv Gastroenterol. 2018;11:1756283X1774662.
[37] Ligaarden SC, Lydersen S, Farup PG. Diet in subjects with irritable bowel syndrome: A cross-sectional study in the general population. BMC Gastroenterol. 2012;12(1):1–8.
[38] Khayyat Y, Attar S. Vitamin D deficiency in patients with irritable bowel syndrome: does it exist? Oman Med J. 2015;30(2):115–8.
[39] Nybacka S, Törnblom H, Josefsson A, Hreinsson JP, Böhn L, Frändemark Å, et al. A low FODMAP diet plus traditional dietary advice versus a low-carbohydrate diet versus pharmacological treatment in irritable bowel syndrome (CARBIS): a single-centre, single-blind, randomised controlled trial. Lancet Gastroenterol Hepatol. 2024;9(6):507–20.
[40] McKenzie YA, Bowyer RK, Leach H, Gulia P, Horobin J, O'Sullivan NA, et al. British Dietetic Association systematic review and evidence-based practice guidelines for the dietary management of irritable bowel syndrome in adults (2016 update). J Hum Nutr Dietetics. 2016;29(5):549–75.
[41] Eswaran SL, Chey WD, Han-Markey T, Ball S, Jackson K. A randomized controlled trial comparing the low FODMAP diet vs modified NICE guidelines in US adults with IBS-D. Am J Gastroenterology. 2016;111(12):1824–32.
[42] Barrett JS. How to institute the low-FODMAP diet. J Gastroenterol Hepatol. 2017;32(S1):8–10.
[43] Sultan N, Varney JE, Halmos EP, Biesiekierski JR, Yao CK, Muir JG, et al. How to implement the 3-phase FODMAP diet into gastroenterological practice. J Neurogastroenterol Motil. 2022;28(3):343–56.
[44] Bertin L, Zanconato M, Crepaldi M, Marasco G, Cremon C, Barbara G, et al. The role of the FODMAP diet in IBS. Nutrients. 2024;16(3):370.
[45] Tuck C, Barrett J. Re-challenging FODMAPs: the low FODMAP diet phase two. J Gastroenterol Hepatol. 2017;32:11–5.
[46] Chey WD, Keefer L, Whelan K, Gibson PR. Behavioral and diet therapies in integrated care for patients with irritable bowel syndrome. Gastroenterology. 2020;160(1):47–62.
[47] El-Salhy M, Gundersen D. Diet in irritable bowel syndrome. Nutr J. 2015;14(1):36.
[48] Haller E, Scarlata K. Diet interventions for irritable bowel syndrome. Gastroenterol Clin North Am. 2021;50(3):565–79.
[49] Mansueto P, Seidita A, D'Alcamo A, Carroccio A. Role of FODMAPs in patients with irritable bowel syndrome. Nutr Clin Pract. 2015;30(5):665–82.
[50] Nybacka S, Störsrud S, Lindqvist HM, Törnblom H, Simrén M, Winkvist A. Habitual FODMAP intake in relation to symptom severity and pattern in patients with irritable bowel syndrome. Nutrients. 2020;13(1):27.
[51] Wilson B, Cox SR, Whelan K. Challenges of the low FODMAP diet for managing irritable bowel syndrome and approaches to their minimisation and mitigation. Proc Nutr Soc. 2021;80(1):19–28.
[52] Böhn L, Störsrud S, Liljebo T, Collin L, Lindfors P, Törnblom H, et al. Diet low in FODMAPs reduces symptoms of irritable bowel syndrome as well as traditional dietary advice: a randomized controlled trial. Gastroenterology. 2015;149(6):1399–407.e2.
[53] Staudacher HM. Nutritional, microbiological and psychosocial implications of the low FODMAP diet. J Gastroenterol Hepatol. 2017;32:16–9.
[54] Bellini M, Tonarelli S, Nagy AG, Pancetti A, Costa F, Ricchiuti A, et al. Low FODMAP diet: evidence, doubts, and hopes. Nutrients. 2020;12(1):148.
[55] O'Keeffe M, Jansen C, Martin L, Williams M, Seamark L, Staudacher HM, et al. Long-term impact of the low-FODMAP diet on gastrointestinal symptoms, dietary intake, patient acceptability, and healthcare utilization in irritable bowel syndrome. Neurogastroenterol Motil. 2017;30(1):e13154.
[56] Tuck CJ, Reed DE, Muir JG, Vanner SJ. Implementation of the low FODMAP diet in functional gastrointestinal symptoms: A real-world experience. Neurogastroenterol Motil. 2019;32(1):e13730.
[57] Cuffe MS, Staudacher HM, Aziz I, Adame EC, Krieger-Grubel C, Madrid AM, et al. Efficacy of dietary interventions in irritable bowel syndrome: a systematic review and network meta-analysis. Lancet Gastroenterol Hepatol. 2025;10(6):520–36.
[58] Zeraattalab-Motlagh S, Ranjbar M, Mohammadi H, Adibi P. Nutritional interventions in adult patients with irritable bowel syndrome: an umbrella review of systematic reviews and meta-analyses of randomized clinical trials. Nutr Rev. 2025;83(3):1343–54.
[59] Strużek K, Karamus K, Rejmak R, Biłogras J, Borowska-Łygan M, Urban W, et al. Low-FODMAP diet in the treatment of irritable bowel syndrome – efficacy, comparison with other diets, mechanisms, and clinical applications. J Educ Health Sport. 2025;80:59059.
[60] Van den Houte K, Colomier E, Routhiaux K, Mariën Z, Schol J, Van den Bergh J, et al. Efficacy and findings of a blinded randomized reintroduction phase for the low FODMAP diet in irritable bowel syndrome. Gastroenterology. 2024;167(2):333–42.
[61] Alrasheedi AA, Jahlan EA, Bakarman MA. The effect of low-FODMAP diet on patients with irritable bowel syndrome. Sci Rep. 2025;15(1):16382.
[62] Shin A. Expanding the menu of dietary therapies in irritable bowel syndrome. Lancet Gastroenterol Hepatol. 2025;10(6):493–5.
[63] Kang SJ. Dietary therapy in irritable bowel syndrome. Korean J Gastroenterol. 2025;85(2):97–104.
[64] Silva Siqueira M, Marques Vieira L. Impact of a low-FODMAPs diet on gastrointestinal symptoms of patients diagnosed with irritable bowel syndrome: a systematic review of the literature. DEMETRA: Alimentação Nutrição Saúde. 2024;19:81934.

[65] Solarz MB, Piekarska J, Solarz JM, Wawrzyńców JT, Cyrkler W, Robak J, et al. The low FODMAP diet in irritable bowel syndrome: Current state of knowledge and therapeutic perspectives. Qual Sport. 2025;40:59768.
[66] Khan Z, Muhammad SA, Amin MS, Gul A. The efficacy of the low-FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) diet in irritable bowel syndrome: a systematic review and meta-analysis. Cureus. 2025;17(1):77053.
[67] Wang J, Yang P, Zhang L, Hou X. A low-FODMAP diet improves the global symptoms and bowel habits of adult IBS patients: a systematic review and meta-analysis. Front Nutr. 2021;8:683191.
[68] van Lanen AS, de Bree A, Greyling A. Efficacy of a low-FODMAP diet in adult irritable bowel syndrome: a systematic review and meta-analysis. Eur J Nutr. 2021;60(6):3505–22.
[69] Khoo XH, Chong CW, Talha AM, Philip K, Teh CS, Isa AM, et al. The impact of diet and ethnicity on gut microbiota variation in irritable bowel syndrome: A multi-center study. J Gastroenterol Hepatol. 2023;38(8):1259–68.
[70] Ingvarsdottir IE, Engilbertsdottir S, Halldorsson TI, Bjornsson ES, Gunnarsdottir I. Gastrointestinal symptoms and dietary intake of patients with irritable bowel syndrome following a low FODMAP diet. Laeknabladid. 2024;110(6):298–306.
[71] Hattori Y, Takama M, Izumi C, Hattori M, Tsukahara T. Effectiveness of a low-FODMAP diet intervention for patients with IBS. Can J Diet Pract Res. 2024;85(3):240.
[72] Hillestad EMR, Steinsvik EK, Teige ES, Rasmussen SH, Brønstad I, Lundervold A, et al. Nutritional safety and status following a 12-week strict low FODMAP diet in patients with irritable bowel syndrome. Neurogastroenterol Motil. 2024;36(7):14814.
[73] Hahn J, Choi J, Chang MJ. Effect of low FODMAPs diet on irritable bowel syndromes: a systematic review and meta-analysis of clinical trials. Nutrients. 2021;13(7):2460.
[74] Manning LP, Tuck CJ, Van Den Houte M, Van Oudenhove L, Biesiekierski JR. Nutritional implications of a three-phase low fermentable oligosaccharide, disaccharide, monosaccharide and polyol diet in irritable bowel syndrome. Proc Nutr Soc. 2025;84:E89.
[75] Chu P, He Y, Hu F, Wang X. The effects of low FODMAP diet on gut microbiota regulation: A systematic review and meta-analysis. J Food Sci. 2025;90(3):70072.
[76] Zhang H, Su Q. Low-FODMAP diet for irritable bowel syndrome: insights from microbiome. Nutrients. 2025;17(3):544.
[77] Staudacher HM, Lomer MCE, Anderson JL, Barrett JS, Muir JG, Irving PM, et al. Fermentable carbohydrate restriction reduces luminal bifidobacteria and gastrointestinal symptoms in patients with irritable bowel syndrome. J Nutr. 2012;142(8):1510–8.
[78] Singh P, Chey SW, Nee J, Eswaran S, Lembo A, Chey WD. Is a simplified, less restrictive low FODMAP diet possible? Results from a double-blind, pilot randomized controlled trial. Clin Gastroenterol Hepatol. 2024;23(2):362–4.
[79] Howley T, Cooney L, Doyle SL. Reframing the management of irritable bowel syndrome: investigating the efficacy of a modified low fodmap diet approach on symptom response. Sci Undergrad Res Exper J. 2024;6(1):7.
[80] Chey WD, Kurlander J, Eswaran S. Irritable bowel syndrome: A clinical review. JAMA. 2015;313(9):949.
[81] Hadjivasilis A. New insights into irritable bowel syndrome: from pathophysiology to treatment. Ann Gastroenterol. 2019;32(6):554–64.
[82] Paduano D, Cingolani A, Tanda E, Usai P. Effect of three diets (low-FODMAP, gluten-free and balanced) on irritable bowel syndrome symptoms and health-related quality of life. Nutrients. 2019;11(7):1566.
[83] Pinto-Sanchez MI, Nardelli A, Borojevic R, Palma GD, Calo NC, McCarville J, et al. Gluten-free diet reduces symptoms, particularly Diarrhea, in patients with irritable bowel syndrome and antigliadin IgG. Clin Gastroenterol Hepatol. 2020;19(11):2343–52.
[84] Shahbazkhani B, Sadeghi A, Malekzadeh R, Khatavi F, Etemadi M, Kalantri E, et al. Non-celiac gluten sensitivity has narrowed the spectrum of irritable bowel syndrome: a double-blind randomized placebo-controlled trial. Nutrients. 2015;7(6):4542–54.
[85] Zanwar VG, Pawar SV, Gambhire PA, Jain SS, Surude RG, Shah VB, et al. Symptomatic improvement with gluten restriction in irritable bowel syndrome: a prospective, randomized, double blinded placebo controlled trial. Intestinal Res. 2016;14(4):343.
[86] Biesiekierski JR, Peters SL, Newnham ED, Rosella O, Muir JG, Gibson PR. No effects of gluten in patients with self-reported non-celiac gluten sensitivity after dietary reduction of fermentable, poorly absorbed, short-chain carbohydrates. Gastroenterology. 2013;145(2):320–8.e3.
[87] Vincenzi M, Del Ciondolo I, Pasquini E, Gennai K, Paolini B. Effects of a low FODMAP diet and specific carbohydrate diet on symptoms and nutritional adequacy of patients with irritable bowel syndrome: Preliminary results of a single-blinded randomized trial. J Transl Intern Med. 2017;5(2):120–6.
[88] Roth B, Nseir M, Jeppsson H, D'Amato M, Sundquist K, Ohlsson B. A starch- and sucrose-reduced diet has similar efficiency as low FODMAP in IBS – A randomized non-inferiority study. Nutrients. 2024;16(17):3039.
[89] Cancarevic I, Rehman M, Iskander B, Lalani S, Malik BH. Is there a correlation between irritable bowel syndrome and lactose intolerance? Cureus. 2020;12(1):e6710.
[90] Shepherd SJ, Gibson PR. Fructose malabsorption and symptoms of irritable bowel syndrome: guidelines for effective dietary management. J Am Diet Assoc. 2006;106(10):1631–9.
[91] Heizer WD, Southern S, McGovern S. The role of diet in symptoms of irritable bowel syndrome in adults: a narrative review. J Am Diet Assoc. 2009;109(7):1204–14.
[92] Rej A, Sanders DS, Shaw CC, Buckle R, Trott N, Agrawal A, et al. Efficacy and acceptability of dietary therapies in non-constipated irritable bowel syndrome: a randomized trial of traditional dietary advice, the low FODMAP diet and the gluten-free diet. Clin Gastroenterol Hepatol. 2022;20(12):2876–87.
[93] Zahedi MJ, Behrouz V, Azimi M. Low fermentable oligo-di-mono-saccharides and polyols diet versus general dietary advice in patients with diarrhea-predominant irritable bowel syndrome: A randomized controlled trial. J Gastroenterol Hepatol. 2018;33(6):1192–9.
[94] O'Brien L, Kasti A, Halmos EP, Tuck C, Varney J. Evolution, adaptation, and new applications of the FODMAP diet. JGH Open. 2024;8(5):e13066.
[95] Black CJ, Ford AC. Personalisation of therapy in irritable bowel syndrome: a hypothesis. Lancet Gastroenterol Hepatol. 2024 Dec;9(12):1162–76.
[96] Connell J, Toma R, Cleo Hanchen Ho, Shen N, Moura P, Le T, et al. Data-driven precision nutrition improves clinical outcomes and risk scores for IBS, depression, anxiety, and T2D. Am J Lifestyle Med. 2023;15598276231216393.

[97] Jactel SN, Olson JM, Wolin KY, Brown J, Pathipati MP, Jagiella VJ, et al. Efficacy of a digital personalized elimination diet for the self-management of irritable bowel syndrome and comorbid irritable bowel syndrome and inflammatory bowel disease. Clin Transl Gastroenterol. 2023;14(1):e00545.

[98] Zarini G, McLean M. S572 A pilot study for precision nutrition in irritable bowel syndrome: in-vitro stimulation of pro-and anti-inflammatory cytokine release. Am J Gastroenterol. 2022;117(10S):e406.

[99] Kasti AN, Katsas K, Pavlidis DE, Stylianakis E, Petsis KI, Lambrinou S, et al. Clinical Trial: A mediterranean low-FODMAP diet alleviates symptoms of non-constipation IBS – randomized controlled study and volatomics analysis. Nutrients. 2025;17(9):1545.

[100] Schnedl WJ, Enko D. Considering histamine in functional gastrointestinal disorders. Crit Rev Food Sci Nutr. 2020;61(17):2960–7.

[101] Mohamed Siraj H, Usaid M, Shaikh S, Dalain M, Ansari Y, Zehra Naqvi S, et al. Bacterial histamine as a therapeutic target for abdominal pain in irritable bowel syndrome: a literature review. Cureus. 2025;17(4):e82132.

[102] Fabisiak A, Włodarczyk J, Fabisiak N, Storr M, Fichna J. Targeting histamine receptors in irritable bowel syndrome: a critical appraisal. J Neurogastroenterol Motil. 2017;23(3):341–8.

[103] Shulpekova YO, Nechaev VM, Popova IR, Deeva TA, Kopylov AT, Malsagova KA, et al. Food intolerance: The role of histamine. Nutrients. 2021;13(9):3207.

[104] Krammer L, Sowa AS, Lorentz A. Mast cells in irritable bowel syndrome: a systematic review. J Gastrointest Liver Dis. 2019;28(4):463–72.

[105] Comas-Basté O, Sánchez-Pérez S, Veciana-Nogués MT, Latorre-Moratalla M, Vidal-Carou MD. Histamine intolerance: the current state of the art. Biomolecules. 2020;10(8):1181.

[106] Orlando A, Chimienti G, Notarnicola M, Russo F. The ketogenic diet improves gut–brain axis in a rat model of irritable bowel syndrome: impact on 5-HT and BDNF systems. Int J Mol Sci. 2022;23(3):1098.

[107] Reddel S, Putignani L, Del Chierico F. The impact of low-FODMAPs, gluten-free, and ketogenic diets on gut microbiota modulation in pathological conditions. Nutrients. 2019;11(2):373.

[108] Santangelo A, Corsello A, Immacolata C, Chiara Maria Trovato, Agostoni C, Orsini A, et al. The influence of ketogenic diet on gut microbiota: potential benefits, risks and indications. Nutrients. 2023;15(17):3680.

[109] Shalan HT, Fathy RA, Bekheet EA. Effect of ketogenic diet on colonic changes of stress induced irritable bowel syndrome of adult male albino rat model (histological and morphometric study). Ain Shams Med J. 2024;75(3):619–36.

[110] Austin GL, Dalton CB, Hu Y, Morris CB, Hankins J, Weinland SR, et al. A very low-carbohydrate diet improves symptoms and quality of life in Diarrhea-predominant irritable bowel syndrome. Clin Gastroenterol Hepatol. 2009;7(6):706–8.e1.

[111] Hujoel IA. Nutritional status in irritable bowel syndrome: A North American population-based study. JGH Open. 2020;4(4):656–62.

[112] Malhotra R, Olver J. Dietary fiber assessment of patients with irritable bowel syndrome from Northern India. Indian J Gastroenterol. 2004;23(6):217–8.

[113] Monsbakken KW, Vandvik PO, Farup PG. Perceived food intolerance in subjects with irritable bowel syndrome– etiology, prevalence and consequences. Eur J Clin Nutr. 2006;60(5):667–72.

[114] McCoubrey H, Parkes GC, Sanderson JD, Lomer MCE. Nutritional intakes in irritable bowel syndrome. J Hum Nutr Diet. 2008;21(4):396–7.

[115] Singh N, Makharia GK, Joshi YK. Dietary survey and total dietary fiber intake in patients with irritable bowel syndrome attending a tertiary referral hospital. Indian J Gastroenterol. 2008;27(2):66–70.

[116] Prescha A, Pieczynska J, Ilow R, Poreba J, Neubauer K, Smereka A, et al. Assessment of dietary intake of patients with irritable bowel syndrome. Rocz Panstw Zakl Hig. 2009;60(2):185–9.

[117] Østgaard H, Hausken T, Gundersen D, El-Salhy M. Diet and effects of diet management on quality of life and symptoms in patients with irritable bowel syndrome. Mol Med Rep. 2012;5(6):1382–90.

[118] Omagari K, Murayama T, Tanaka Y, Yoshikawa C, Inoue SI, Ichimura M, et al. Mental, physical, dietary, and nutritional effects on irritable bowel syndrome in young Japanese women. Intern Med. 2013;52(12):1295–301.

[119] Tigchelaar EF, Mujagic Z, Zhernakova A, Hesselink MA, Meijboom S, Perenboom CW, et al. Habitual diet and diet quality in Irritable Bowel Syndrome: A case-control study. Neurogastroenterol Motil. 2017;29(12):e13151.

[120] Alharbi SH, Alateeq FA, Alshammari KI, Alshammri ASS, Alabdali NAN, Alsulaiman MAS, et al. Irritable bowel syndrome and dietary habits in Northern Saudi Arabia. Health. 2019;11(3):289–97.

[121] Nilholm C, Larsson E, Roth B, Gustafsson R, Ohlsson B. Irregular dietary habits with a high intake of cereals and sweets are associated with more severe gastrointestinal symptoms in IBS patients. Nutrients. 2019;11(6):1279.

[122] Yilmaz B, Akbulut G. The evaluation of the nutritional status in patients with irritable bowel syndrome. Clin Exp Health Sci. 2021;11(1):119–26.

[123] Shafiee NH, Razalli NH, Mokhtar NM, Tan E, Ali RAR. An evaluation of dietary adequacy among patients with constipation-predominant irritable bowel syndrome in Malaysia. Intestinal Res. 2021;20(1);124–33.