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British Dietetic Association evidence-based guidelines for the dietary management of irritable bowel syndrome in adults

Y. A. McKenzie,* A. Alder,† W. Anderson,‡ A. Wills,§ L. Goddard,¶ P. Gulia,** E. Jankovich,†† P. Mutch,‡‡ L. B. Reeves,§§ A. Singer¶¶ & M. C. E. Lomer*** on behalf of Gastroenterology Specialist Group of the British Dietetic Association

*Nuffield Health The Manor Hospital, Oxford, UK
†Department of Nutrition and Dietetics, Royal Sussex County Hospital, Brighton, UK
‡Waistlines Service Cannock Chase Commissioning Consortium, West Locality Office, Cannock, UK
§Nutrition and Dietetic Department, Southampton General Hospital, Hampshire, UK
¶Imperial College Healthcare NHS Trust, St Mary's Hospital, London, UK
**Department of Nutrition and Dietetics, Sandwell General Hospital, West Midlands, UK
††Private Practice, Constantia, Cape Town, South Africa
‡‡Positive Dietetics, Aberdeen, UK
§§Community Nutrition and Dietetic Department, Oxford Health NHS Foundation Trust, Oxford, UK
¶¶Department of Nutrition and Dietetics, North Bristol NHS Trust, Frenchay Hospital, Bristol, UK
***Diabetes & Nutritional Sciences Division, King's College London, London, UK

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Correspondence
Y. McKenzie, Nuffield Health The Manor Hospital, Beech Road, Headington, Oxford OX3 7RP, UK.
Tel.: +44 079 66 87 8758
Fax: +44 018 65 30 7788
E-mail: yvonne@digestiblenutrition.co.uk

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Abstract

Background: Irritable bowel syndrome (IBS) is a chronic debilitating functional gastrointestinal disorder. Diet and lifestyle changes are important management strategies. The aim of these guidelines is to systematically review key aspects of the dietary management of IBS, with the aim of providing evidence-based guidelines for use by registered dietitians.
Methods: Questions relating to diet and IBS symptom management were developed by a guideline development group. These included the role of milk and lactose, nonstarch polysaccharides (NSP), fermentable carbohydrates in abdominal bloating, probiotics and empirical or elimination diets. A comprehensive literature search was conducted and relevant studies from January 1985 to November 2009 were identified using the electronic database search engines: Cinahl, Cochrane Library, Embase, Medline, Scopus and Web of Science. Evidence statements, recommendations, good practice points and research recommendations were developed.
Results: Thirty studies were critically appraised. A dietetic care pathway was produced following a logical sequence of treatment and formed the basis of these guidelines. Three lines of dietary management were identified. First line: Clinical and dietary assessment, healthy eating and lifestyle management with some general advice on lactose and NSP. Second line: Advanced dietary interventions to improve symptoms based on NSP, fermentable carbohydrates and probiotics. Third line: Elimination and empirical diets. Research recommendations were also identified relating to the need for adequately powered and well designed randomised controlled trials.
Conclusions: These guidelines provide evidence-based details of how to achieve the successful dietary management of IBS.

Introduction

Irritable bowel syndrome (IBS) is a chronic and debilitating functional gastrointestinal disorder that affects 9–23% of the population across the world (World Gastroenterology Organisation, 2009). The aetiology is poorly understood and many factors are involved, including gut hypersensitivity, low-grade mucosal inflammation, disturbed colonic motility and previous gastrointestinal infection (Drossman *et al.*, 2002; Neal *et al.*, 2002; Parry & Forgacs, 2005). Symptoms include abdominal pain and/or bloating associated with a disordered bowel habit and can severely impair quality of life. Precipitating features such as stress, anxiety and a hectic lifestyle add to the burden of IBS increasing symptoms further (Halpert *et al.*, 2007). Recognised subtypes of IBS are diarrhoea predominant (IBS-D), constipation predominant (IBS-C), mixed diarrhoea and constipation (IBS-M), and unspecified (Longstreth *et al.*, 2006).

Most people with IBS report that diet affects their symptoms and they often alter what they eat to alleviate these (Monsbakken *et al.*, 2006; Halpert *et al.*, 2007).

Diet and lifestyle changes are important (Burden, 2001; Heizer *et al.*, 2009), although there are no guidelines that have systematically reviewed the evidence [Spiller *et al.*, 2007; National Institute for Health and Clinical Excellence (NICE), 2008, Brandt *et al.*, 2009].

The aim of these guidelines is to systematically review key aspects of the dietary management of IBS in adults, with the aim of providing evidence-based guidelines for use by registered dietitians. This will improve evidence-based practice, clinical effectiveness and patient outcomes. In particular, these guidelines pertain to aspects of practice relevant to the UK context. These guidelines do not consider children (<18 years) with IBS.

Materials and methods

An IBS dietetic guideline development group (IBS-DGDG) was formed consisting of registered dietitians belonging to the Gastroenterology Specialist Group of The British Dietetic Association (BDA). Five key questions were devised based on research literature, clinical practice, emerging evidence and gaps in the dietetic evidence base, focusing on IBS symptom improvement in relation to milk and dairy avoidance, nonstarch polysaccharide (NSP) intake, fermentable carbohydrate intake specifically aimed at reducing abdominal bloating, UK-available probiotics and elimination/empirical diets. Generic criteria for each question were set up relating to Participants, Interventions, Comparisons, Outcome measures and Types of study (PICOT) (Table 1). Search terms and inclusion criteria for each question are described in the full BDA guidelines provided in the Supporting Information file.

A comprehensive, systematic literature search was conducted, and relevant studies from January 1985 to November 2009 were identified using electronic databases (Cinahl, Cochrane Library, Embase, Medline, Scopus and Web of Science). Studies conducted before 1985 were excluded as a result of inadequate definitions of IBS and insufficiently described methodology. For each topic, two members of the IBS-DGDG independently assessed the studies retrieved for evaluation. Where there was disagreement, full papers were screened to assess whether they met the inclusion criteria. Reference lists of included studies were cross-searched for other studies of potential relevance. Papers were critically appraised using the Critical Appraisal Skills Programme tool (Public Health Resource Unit, 2007).

Included studies were presented to the IBS-DGDG for considered judgement as set out by the Scottish Intercollegiate

Table 1 Generic inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Participants	Adults (≥18 years)*	Pregnancy
	Definitions for IBS: Manning, Rome I, Rome II or Rome III (Manning *et al.*, 1978; Drossman, 2006) or clearly defined IBS diagnostic criteria as those used in clinical practice ruling out other gastrointestinal pathologies	Studies including other functional gastrointestinal disorders
Interventions	Topic specific	
Comparisons	Intervention diet compared to placebo, no treatment or another dietary component	
Outcome measures	Primary: clinical effectiveness on global or individual IBS symptoms between groups	
	Secondary: adverse events arising from the dietary intervention	
	Where *P*-values are reported, they refer to differences between the intervention and control*	
Types of study	Individual intervention studies and systematic reviews	Nonsystematic reviews, case studies, retrospective audits or studies in abstract form only
	English language	Studies with fewer than 10 IBS participants were excluded

*Except where indicated. IBS, irritable bowel syndrome.

Guidelines Network (SIGN) using standard levels of evidence and grading of recommendations (SIGN, 2008). For each of the five questions examined, evidence statements were formed and used to develop clinical and research recommendations and practical considerations, as presented in the Results. The terms 'limited' or 'moderate' and 'weak' or 'good' were used to describe the volume and quality of evidence, respectively. The final draft was peer reviewed and ratified by the BDA Professional Practice Board.

Results

The literature search identified a potential 1163 papers. Of these, only 112 were considered suitable for retrieval; however, only 30 met the inclusion criteria. The final guidelines were peer reviewed by 35 gastroenterologists, general practitioners, registered dietitians and researchers. First-line general considerations were included to complete the guideline from the point of referral (Table 2). Twenty-two evidence statements, 13 clinical practice recommendations (Table 3) and research recommendations were agreed by the IBS-DGDG. An IBS algorithm was devised to aid standardisation of dietetic clinical practice (Fig. 1).

1.0 Removing milk and dairy products to improve irritable bowel syndrome symptoms

Many individuals with IBS have tried milk or dairy avoidance and often have low calcium intakes (McCoubrey *et al.*, 2008). To avoid unnecessary exclusion and potential dietary deficiencies, it is important to review the evidence for removing milk and dairy products, which includes lactose avoidance, and its effectiveness in improving IBS symptoms.

Lactose is a disaccharide uniquely found in mammalian milk that is hydrolysed in the jejunum by the enzyme lactase. A genetically programmed decline in lactase activity after weaning resulting in lactase nonpersistence occurs in 70% of individuals, depending on ethnicity (Lomer *et al.*, 2008).

Table 2 First-line general considerations

1	Rule out 'red flags' (NICE, 2008)
	Full blood count, erythrocyte sedimentation rate and C-reactive should be normal
	Rule out coeliac disease
	Endomysial antibodies (IgA-EMA) or tissue transglutaminase (IgA-tTG) should be negative. If positive, a gastroscopy with duodenal (D2) biopsies should be carried out. Check that coeliac screening was carried out when the individual was taking gluten in the diet in more than one meal every day for at least 6 weeks before testing (NICE, 2009). If coeliac antibodies have not been checked, request tests before making any dietary changes to gluten intake
	Note: In individuals with IgA-deficiency, use IgG-tTG to test for coeliac disease (Hopper *et al.*, 2008)
2	Discuss IBS as a positive diagnosis with the patient (NICE, 2008)
	The term 'functional bowel disorder' is often better accepted (Longstreth *et al.*, 2006)
3	Assess symptom profile (to measure change: repeat at follow-up)
	Explain that you are going to ask questions relating to bowel habit and other symptoms (take into account that some individuals find it difficult to talk about their bowels). Identify the most troublesome symptom(s). Measure severity and frequency of individual symptoms (e.g. using a symptom severity score, a 10-cm visual analogue scale or a Likert scale). Assess stool consistency (e.g. use the Bristol stool form chart) (Lewis & Heaton, 1997). Recording bowel frequency and feelings of either urgency to open bowels and/or incomplete evacuation after defaecation may be useful. Classify as IBS-C, IBS-D or IBS-M
4	Record medical and family history
	Specifically record any allergies and intolerances (especially food) and IBS medication (e.g. antispasmodics, laxatives, anti-motility agents, tricyclics and selective serotonin re-uptake inhibitors)
	Assess family gastrointestinal problems (e.g. coeliac disease, inflammatory bowel disease or IBS, histoy of constipation, childhood bowel problems)
	Assess and monitor anthropometry (weight, BMI and weight history)
5	Assess dietary choices, eating habits, lifestyle and other factors that may be contributing to symptoms
	Before the first appointment, it may be useful to ask individuals to keep a food and symptom diary. Consider frequency and timing of symptoms (e.g. meal-related, daily, nocturnal, weekdays, weekends, holidays, exercise induced, and, for women only, whether symptoms are related to their menstrual cycle, gut hypersensitivity)
	With specific food avoidances: explore how the individual thinks the foods affect their IBS symptoms
	Assess the eating pattern and usual dietary intake of dietary fibre, fatty foods, fluid, caffeine, alcohol and milk and/or lactose
	Where hydrogen breath tests are available (e.g. lactose, fructose, lactulose), results may identify which dietary management strategy is most appropriate and avoid the need for unnecessary food restrictions
	Encourage a healthy eating pattern with a good variety of foods to achieve nutritional adequacy. Use general healthy eating guidelines with special attention to eating regularly, good eating behaviour (taking time over meals, sitting down to eat, chewing food thoroughly, not eating late at night) and drinking plenty of caffeine free, alcohol free, nonfizzy fluids spread throughout the day, aim for 1.5–3.0 L per day (35 mL kg^{-1} body weight)

IBS, irritable bowel syndrome; IBS-C, constipation predominant irritable bowel syndrome; IBS-D, diarrhoea predominant irritable bowel syndrome; IBS-M, irritable bowel syndrome with mixed bowel pattern.

Table 3 Clinical practice recommendations

	Grade of recommendation
1.0 Removing milk and dairy products to improve IBS symptoms	
In individuals where sensitivity to milk is suspected and a lactose hydrogen breath test is not available or appropriate, a trial period of a low lactose diet is recommended. This is particularly useful in individuals with an ethnic background with a high prevalence of primary lactase deficiency	D
Use a low lactose diet to treat individuals with a positive lactose hydrogen breath test	D
In individuals where milk is suspected as a problem food and symptoms do not improve on a low lactose diet, assess other components of milk (e.g. cow's milk protein) as a contributing factor. Recommend a milk free diet or, in some cases, an alternative mammalian milk	D
2.0 Nonstarch polysaccharides	
Avoid using dietary supplementation of wheat bran to treat IBS. Individuals should not be advised to increase their intake of wheat bran above their usual dietary intake	C
For individuals with IBS-C, dietary supplementation of ground linseeds can be recommended for a 3-month trial. Improvements in constipation, abdominal pain and bloating from linseed supplementation may be gradual	D
3.0 Fermentable carbohydrates	
For individuals with IBS and suspected or diagnosed fructose malabsorption, assess dietary intake of all short-chain fermentable carbohydrates (fructose, fructans, galacto-oligosaccharides and polyols). There is likely to be a benefit in reducing intake	B
For individuals with IBS and abdominal bloating, abdominal pain and/or flatulence, assess dietary intake of fermentable carbohydrates because there may be a benefit in reducing intake	D
There may be individual tolerance levels to fermentable carbohydrates. A planned and systematic challenge of foods high in fermentable carbohydrates will identify which foods can be reintroduced to the diet and what individual tolerance levels are	D
4.0 Probiotics	
Probiotics can be considered, ideally, after assessing the effectiveness of restricting intake of fermentable carbohydrates. Advise individuals choosing to try probiotics to select one product at a time and monitor the effects. They should try it for a minimum of 4 weeks at the dose recommended by the manufacturer	B
There is considered to be no associated harm in taking probiotics for individuals with IBS	B
5.0 Empirical and elimination diets	
Where food is considered to be a trigger for IBS symptoms, particularly IBS-D, an elimination or empirical diet can be considered	D
The initial phase of an elimination or empirical diet should be followed for 2–4 weeks	D
If there is no symptom improvement within 2–4 weeks of the initial phase of an elimination or empirical diet and foods consumed within the diet were not suspected symptom triggers, specific foods are an unlikely cause of IBS symptoms	D

IBS, irritable bowel syndrome; IBS-C, constipation predominant irritable bowel syndrome; IBS-D, diarrhoea predominant irritable bowel syndrome; IBS-M, irritable bowel syndrome with mixed bowel pattern.

Lactose malabsorption is defined as incomplete hydrolysis of lactose resulting in the presence of unabsorbed lactose in the colonic lumen (Montalto *et al.*, 2006). Lactose intolerance leads to gastrointestinal symptoms similar to those of IBS (i.e. abdominal pain, bloating, flatulence and loose stools resulting from colonic bacterial fermentation) (Mascolo & Saltzman, 1998). Generally, individuals with lactose malabsorption can tolerate up to 13 g of lactose (approximately 250–300 mL of milk, spread throughout the day) without developing symptoms (Suarez *et al.*, 1995).

Included studies and evidence statements

Five studies were considered eligible for inclusion and were evaluated as summarised in Table 4 (Bozzani *et al.*, 1986; Vernia *et al.*, 1995; Bohmer & Tuynman, 1996, 2001; Parker *et al.*, 2001). These nonrandomised controlled trials (RCTs) assessing either a low lactose diet compared to no dietary restriction or no dietary intervention were critically appraised and resulted in the evidence statements outlined below:

1.1 There is limited weak evidence for an increased incidence of lactose malabsorption in individuals with IBS compared to individuals without IBS from a white, Caucasian, Northern European background, when tested using a hydrogen breath test with a lactose load in the range 25–50 g (Bohmer & Tuynman, 1996; Parker *et al.*, 2001) SIGN 2−

1.2 There is limited weak evidence to show that the incidence of lactose malabsorption is higher in individuals with IBS from ethnic groups with a higher prevalence of primary lactase deficiency (Bozzani *et al.*, 1986; Vernia *et al.*, 1995) SIGN 2−

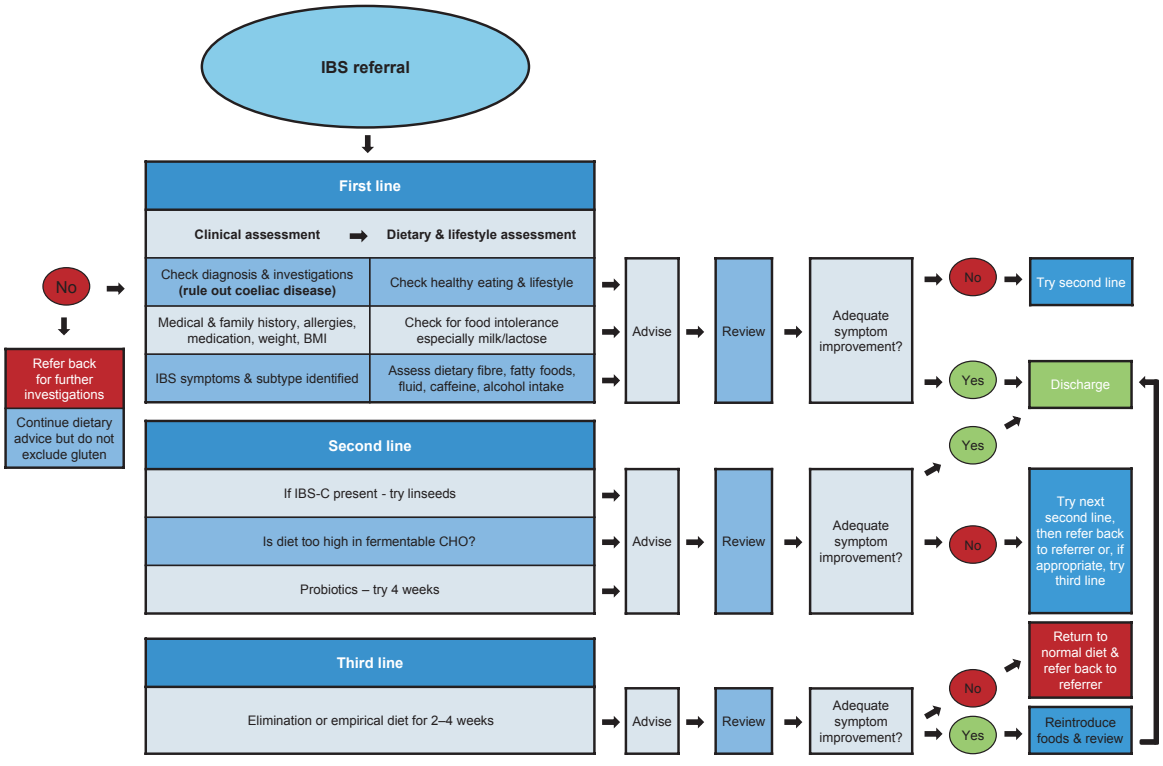

Figure 1 If first-line dietary assessment and interventions indicate that further dietary changes are necessary to improve symptoms, consider second-line advanced dietary interventions with linseed supplementation for constipation predominant irritable bowel syndrome (IBS-C) followed by an assessment and alteration of fermentable carbohydrate intake. Intervention using a probiotic to further improve IBS symptoms can be considered secondary to other second-line advanced dietary interventions. If second-line advanced dietary interventions fail to improve symptoms, consider third-line options (an elimination or empirical diet) or, if this is not appropriate, refer back to the referring clinician as diet may not be the most effective management. BMI, body mass index; CHO, carbohydrate.

Table 4 Studies included relating to dairy/lactose

Study	Study design and *N*	Intervention + duration	Outcome on global symptoms	SIGN
Bohmer & Tuynman, 1996	DB non-RCT 70 with IBS	Low lactose diet (<9 g per day) for 6 weeks	Symptom scores: baseline to 6 weeks	2–
		17/70 LHBT +ve	LHBT +ve: 13.5–4; $P < 0.001$	
		53/70 LHBT –ve	LHBT –ve: 13–11; $P > 0.05$*	
Bohmer & Tuynman, 2001	Non-RCT 16 with IBS and LHBT +ve	Low lactose diet for 5 years	Symptom scores: baseline to 5 years 13.5–5.1; $P < 0.001$	2–
Bozzani *et al.*, 1986	Non-RCT 40 with IBS and LHBT +ve	Lactose free diet (<9 g per day) for 4 months	Symptoms assessment at 4 months: three symptom free, 21 improved and 16 no change (NS)*	2–
Parker *et al.*, 2001	Non RCT 33 with IBS and LHBT +ve	Low lactose diet (<1 g per day) for 3 weeks	9 improved versus 14 did not improve* 10 withdrawals/lost to follow-up	2–
Vernia *et al.*, 1995	Non-RCT 110 with IBS and +ve LHBT	Lactose free diet for 3 months	48 remission, 43 partial improvement and 17 no improvement* Two unaccounted for	2–

**P*-value not reported. DB, double-blind; IBS, irritable bowel syndrome; LHBT, lactose hydrogen breath test; NS, not significant; RCT, randomised controlled trial; SIGN, Scottish Intercollegiate Guidelines Network level of evidence; +ve, positive; –ve, negative.

1.3 There is moderate weak evidence that, in individuals with IBS with a positive diagnosis of lactose malabsorption using a hydrogen breath test, a low lactose diet reduces short- and long-term abdominal symptoms (Bozzani *et al.*, 1986; Vernia *et al.*, 1995; Bohmer & Tuynman, 1996) SIGN 2–

1.4 There is no evidence that suggests a particular IBS symptom profile indicates lactose intolerance or responds better to a low lactose diet (Bohmer & Tuynman, 1996; Parker *et al.*, 2001) SIGN 2−

1.5 There is limited weak evidence that, if milk is suspected to be a problem from the individual's diet history, and a low lactose diet does not improve IBS symptoms, then other components of milk (e.g. cow's milk protein) should be explored for their exclusion to determine if symptoms improve (Parker *et al.*, 2001) SIGN 2−

1.6 Lactose intolerance is a recognised condition in itself and should be ruled out before the diagnosis of IBS is made (Vernia *et al.*, 1995; Bohmer & Tuynman, 1996, 2001) SIGN 4

Practical considerations

When applying these evidence statements and recommendations, a number of factors are important. A detailed dietary assessment of milk and/or lactose intake should be used not only to assess specific nutrient intake (e.g. calcium), but also to assess lactose tolerance (i.e. symptoms are worse following days of higher milk/lactose consumption).

IBS and lactose intolerance have similar symptom profiles; therefore, a lactose hydrogen breath test can be useful to distinguish between the two and may assist with dietary management. However, hydrogen breath test facilities are not always available and the results may be inconclusive. In such circumstances, exclusion and challenge with lactose containing foods can be useful for assessing tolerance.

Some individuals with IBS avoid milk or dairy products to alleviate symptoms and it is difficult to identify which component of these foods is responsible. Gradual lactose reintroduction may be useful to determine an individual's lactose tolerance threshold. However, other components of milk may be responsible for these symptoms (e.g. cow's milk proteins). If cow's milk proteins are not tolerated, the initial recommendation should be a non-mammalian alternative milk (e.g. soya, rice, oat, quinoa, nut, coconut or pea, preferably calcium fortified), rather than other mammalian milks (e.g. goat's or sheep's) that have similar milk proteins.

Lactose restriction to achieve symptom improvement and re-challenge is recommended to identify an individual's tolerance. If symptoms continue with re-introduction, a re-test is required at a later date. The inclusion of some milk or dairy products increases dietary variety and may improve nutritional adequacy.

2.0 Changes in nonstarch polysaccharides to improve irritable bowel syndrome symptoms

NSP (dietary fibre) are composed of 'non-α-glucan polysaccharides that are mainly found in plant cell walls. This includes cellulose, hemicellulose, pectin, arabinoxylans, plant gums, β-glucans' [Scientific Advisory Committee on Nutrition (SACN), 2008]. Soluble fibre (e.g. pectin, β-glucan from oats and barley, and gums in psyllium) generally undergoes significant fermentation, whereas insoluble fibre (e.g. celluloses, some hemicelluloses and lignin) tends to undergo slow and incomplete fermentation and has a greater effect on bowel habit by increasing faecal weight (SACN, 2008).

Alterations in NSP intake are the mainstay of dietary management of IBS. However, there is conflicting evidence for increasing or decreasing intakes. These guidelines assess the research specifically relating to NSP that is provided within the diet, including food supplementation (i.e. using any cereal bran, linseeds and psyllium husk) and do not assess medicines or herbal preparations.

Included studies and evidence statements

Ten RCTs fulfilled the inclusion criteria and were evaluated as summarised in Table 5 (Arffmann *et al.*, 1985; Kruis *et al.*, 1986; Lucey *et al.*, 1987; Fowlie *et al.*, 1992; Snook & Shepherd, 1994; Hebden *et al.*, 2002; Aller *et al.*, 2004; Tarpila *et al.*, 2004; Rees *et al.*, 2005; Bijkerk *et al.*, 2009). They assessed NSP intake using wheat bran, linseeds (ground) or combined food sources. No interventions used oats, other bran types or whole linseeds. The following evidence statements were developed:

2.1 There is moderate good evidence that wheat bran fibre does not improve IBS symptoms (Kruis *et al.*, 1986; Lucey *et al.*, 1987; Snook & Shepherd, 1994; Hebden *et al.*, 2002; Rees *et al.*, 2005; Bijkerk *et al.*, 2009) SIGN 1−

2.2 There is limited weak evidence that increasing NSP from mixed food sources does not improve IBS symptoms (Fowlie *et al.*, 1992; Aller *et al.*, 2004) SIGN 2−

2.3 There is limited weak evidence that ground linseeds relieve constipation, abdominal discomfort and bloating in IBS-C (Tarpila *et al.*, 2004) SIGN 2−

2.4 There is limited weak evidence that IBS-C symptoms improve slowly over time in response to ground linseeds (Tarpila *et al.*, 2004) SIGN 2−

Practical considerations

With reported symptoms in mind, an assessment of the intake of NSP from all food sources (cereals, grains, fruits, vegetables, nuts and seeds) is required to determine whether current intake is optimal for that individual and avoid adding wheat bran. For the addition of ground linseeds, this should start with one teaspoon to one tablespoon per day and build up to a maximum of four tablespoons (24 g) per day taken with a drink (150 mL of fluid per tablespoon (Blumenthal, 1998). Linseeds can be added to food (e.g. yoghurt, breakfast cereal, soup, salad).

Table 5 Studies included relating to nonstarch polysaccharides

Study	Study design and *N*	Intervention (*n*/*N*) + duration	Outcome on global symptoms	SIGN
Arffmann *et al.*, 1985	DB RCT CO 20 with IBS-C or IBS-M	Bran (12 g NSP) (18/20) versus placebo for 6 weeks washout duration not stated	No significant difference between groups for symptoms*	1–
Bijkerk *et al.*, 2009	DB RCT 3 arm 275 with IBS	Bran (4 g NSP) (54/97) versus psyllium (4 g NSP) (54/85) versus placebo (56/93) for 12 weeks	No significant difference between bran versus placebo for symptoms; $P = 0.61$	1++
			Significant improvement between psyllium versus placebo for symptoms; $P = 0.03$	
Hebden *et al.*, 2002	DB RCT CO 12 with IBS	Bran (11 g NSP) (12) versus placebo (0.5 g NSP) for 4 days washout duration 2 weeks	Bran significantly increased pain and bloating versus placebo; $P < 0.02$	1–
Kruis *et al.*, 1986	DB RCT 80 with IBS	Bran (11 g NSP) (40) versus placebo (40) for 16 weeks	No significant difference between groups for symptoms*	1–
Lucey *et al.*, 1987	DB RCT CO 38 with IBS	Bran (15.6 g NSP) (28) versus placebo (2.8 g NSP) (28) for 16 weeks	No significant difference between groups for symptoms*	1–
Rees *et al.*, 2005	SB RCT 28 with IBS-C or IBS-M	Bran (2–4 g NSP) (12/14) versus placebo (0.2–0.4 g NSP) (10/14) for 12 weeks	No significant difference between groups for symptoms*	1–
Snook & Shepherd, 1994	DB RCT CO 80 with IBS	Bran (12 g NSP) (71/80) versus placebo (71/80)	No significant difference between groups for symptoms*	1–
Aller *et al.*, 2004	SB RCT 56 with IBS	High fibre diet (30.5 g NSP) (28) versus low fibre diet (10.4 g NSP) (28) for 3 months	No significant difference between groups for symptoms*	1–
Fowlie *et al.*, 1992	Non RCT 49 with IBS-C	Cereal and fruit fibre tablet (4.1 g NSP) (21) versus placebo for 3 months	No significant difference between groups for symptoms*	2–
Tarpila *et al.*, 2004	SB RCT 55 with IBS-C	Linseeds (up to 8 g NSP) (26) versus psyllium (up to 2.25 g NSP) (29) for 3 months	Linseeds improved constipation ($P = 0.05$), abdominal symptoms ($P = 0.001$)	2–

**P*-value not reported. Bran, wheat bran; CO, cross-over; DB, double-blind; IBS, irritable bowel syndrome; *N*, number recruited; *n*, number completed; *n*/*N*, withdrawals; NS, not significant; NSP, nonstarch polysaccharide; RCT, randomised controlled trial; SB, single blind; SIGN, Scottish Intercollegiate Guidelines Network level of evidence; +ve, positive; –ve, negative; IBS-C, constipation predominant irritable bowel syndrome; IBS-M, irritable bowel syndrome with mixed bowel pattern.

Some individuals may choose to use whole linseeds, which are generally considered safe in IBS.

3.0 Abdominal bloating in irritable bowel syndrome and the role of fermentable carbohydrates

Abdominal bloating occurs in up to 96% of individuals with IBS (Houghton *et al.*, 2006) and is the most bothersome symptom, increasing in severity with eating and as the day progresses, and then settling overnight (Maxton *et al.*, 1991). Bloating can seriously impair quality of life, substantially limiting an individual's daily working, physical and recreational activities.

Fermentable carbohydrates are poorly absorbed, osmotically active and undergo bacterial fermentation in the human gut, leading to loose stools and gas production (Barrett *et al.*, 2010; Ong *et al.*, 2010). They include fructo-oligosaccharides (FOS) (e.g. fructans in wheat and onion), galacto-oligosaccharides (GOS) (e.g. in beans and pulses), disaccharides [e.g. lactose in milk and dairy products, monosaccharides (in particular fructose in excess of glucose, e.g. mango, honey or a high fructose load, e.g. fruit juice, fructose ingredients in processed foods and drinks)], and polyols (e.g. sorbitol in various fruit and vegetables, polyol sweetened sugar-free manufactured foods and medicines) - FODMAPs, and resistant starches (e.g. in green banana, cold or reheated potato). Some have positive physiological effects on colonic health, lowering disease risk, although direct data are lacking (Topping & Clifton, 2001). The benefits of increasing fermentable carbohydrates in the diet are limited as a result of poor gastrointestinal tolerance (Livesey, 2001; Grabitske & Slavin, 2009) inducing abdominal bloating in health (Langlands *et al.*, 2004)

Table 6 Studies included relating to fermentable carbohydrates

Study	Study design and *N*	Intervention + duration	Outcome on bloating	SIGN
Olesen & Gudmand-Hoyer, 2000	DB RCT 98 with IBS	FOS# (10 g per day for 2 weeks then 20 g per day for 10 weeks) (38/52) or placebo (20 g per day glucose) (37/46) for 12 weeks	PP 96/98	1–
			No significant differences in symptom provocation between groups*, 21.7% versus 23.3% improvement for 20 g per day dose	
Shepherd *et al.*, 2008	DB RCT CO 4 arms 26 with IBS and fructose malabsorption	Low dose (fructans* 7 g per day and/or fructose 14 g per day) versus medium dose (fructans 14 g per day and/or fructose 28 g per day) versus high dose (fructans 19 g per day and/or fructose 50 g per day) versus placebo (glucose: low dose 7 g per day, medium dose 14 g per day, high dose 20 g per day) for 3 days	ITT 24/26	1+
		Baseline low FODMAP diet ≥10 days and washout in between doses ≥10 days	Significantly more symptoms reported in fructose (79%), fructans (77%) and fructose/fructan mix (79%) groups compared to placebo (14% $P \leq 0.002$)*	
Silk *et al.*, 2009	SB RCT 3 arms 60 with IBS	Low dose (3.5 g perday placebo and 3.5 g per day *trans*-GOS## versus high dose (7 g per day placebo and 7 g per day *trans*-GOS versus high dose placebo (7.0 g per day maltodextrins and 7.0 g per day maltodextrins)	PP 44/60	1–
		Baseline 14 days, placebo 28 days, washout 14 days followed by intervention or placebo 28 days	32% less bloating for low dose *trans*-GOS ($P < 0.05$); 27% increase in bloating for high dose *trans*-GOS ($P < 0.05$)	
Symons *et al.*, 1992	DB RCT CO 15 with IBS-D or IBS-M	Low dose (fructose 20 g and sorbitol 3.5 g) versus high dose (fructose 25 g and sorbitol 5 g)	ITT 15/15	1–
		One off dose after a 12 h overnight fast. Washout duration not reported	Significantly higher score for the higher dose compared with the lower dose ($P = 0.03$)	

**P*-value for effect on bloating not reported and so values represent global symptoms. CO, cross-over; DB, double-blind; FOS#, fructo-oligosaccharide – inulin from chicory root: Idolax [Orafti], Fructans* Raftilose P-95 [Orafti]; IBS, irritable bowel syndrome; ITT, intention-to-treat; *N*, number recruited; *n*, number completed; *n/N*, withdrawals; PP, per protocol analysis; RCT, randomised controlled trial; SB, single blind; SIGN, Scottish Intercollegiate Guidelines Network level of evidence; *trans*-GOS##, *trans*-galacto-oligosaccharide powder, made from *Bifidobacterium bifidum* NCIMD 41171 containing 22% lactose made up with water as a banana or chocolate flavoured drink; IBS-D, diarrhoea predominant irritable bowel syndrome; IBS-M, irritable bowel syndrome with mixed bowel pattern.

and symptoms in functional gut disorders, such as IBS (Ong *et al.*, 2010).

These guidelines focus on the role of fermentable carbohydrates, specifically in abdominal bloating, assessing research into dietary restriction and supplementation.

Included studies and evidence statements

Four RCTs met the inclusion criteria and were evaluated as summarised in Table 6 (Symons *et al.*, 1992; Olesen & Gudmand-Hoyer, 2000; Shepherd *et al.*, 2008; Silk *et al.*, 2009). The studies assessed the intake of fructose, fructans, namely FOS, and sorbitol in relation to symptom provocation or *trans*-GOS in relation to symptom reduction. No studies assessed resistant starch. The following evidence statements were developed:

3.1 There is limited good evidence that, following a period on a low FODMAP diet, the re-introduction of fructose and fructans can precipitate worse bloating in individuals with IBS (Shepherd *et al.*, 2008) SIGN 1+

3.2 There is moderate good evidence that high doses of fructans, sorbitol and *trans*-GOS increase the severity of bloating in individuals with IBS (Symons *et al.*, 1992;

Shepherd *et al.*, 2008; Silk *et al.*, 2009) High doses of fructose provoke more bloating in individuals with IBS with fructose malabsorption (Shepherd *et al.*, 2008) SIGN 1−

3.3 There is limited good evidence that, following a period on a low FODMAP diet, the re-introduction of fructose and fructans can precipitate a worsening of abdominal pain and flatulence but not nausea or tiredness in individuals with IBS (Shepherd *et al.*, 2008) SIGN 1+

3.4 In individuals with IBS, who are intolerant to fructose and sorbitol, there is limited weak evidence that abdominal bloating does not occur during ingestion but up to 24 h following consumption (Symons *et al.*, 1992) SIGN 1−

3.5 There is limited weak evidence that 3.5 g per day of *trans*-GOS reduces bloating in IBS over a 4-week period. There was no beneficial effect of 7.0 g per day (Silk *et al.*, 2009) SIGN 1−

Practical considerations

Avoidance of fermentable carbohydrates, particularly FODMAPs, is an emerging treatment for IBS and requires specialist dietetic knowledge, including expertise in their effects in the gut and dietary sources (Gibson & Shepherd, 2010; Gibson, 2011; Staudacher *et al.*, 2011).

Successful compliance and symptom management is achieved by the provision of detailed resources on the avoidance of the relevant foods high in fermentable carbohydrates, including suitable alternatives to ensure the diet is nutritionally adequate (Gibson & Shepherd, 2010). Following symptom resolution (2–8 weeks) (Staudacher *et al.*, 2011), planned and systematic re-introduction of foods high in fermentable carbohydrates verifies individual tolerance to specific fermentable carbohydrates and increases dietary variety.

4.0 Probiotics in managing irritable bowel syndrome symptoms

Probiotics are live microorganisms that, when administered in adequate amounts, confer a health benefit on the host (Food and Agriculture Organisation/World Health Organisation, 2001). Recent European legislation indicates that health claims such as 'probiotics' refer to a function in the body and need to be authorised (Food Standards Agency, 2008). Mechanisms of how probiotics may improve IBS symptoms include an alteration of the integrity of the gut mucosa to decrease intestinal permeability, a reduction in mucosal inflammation and immune stimulation (Parkes *et al.*, 2010).

Probiotics are available as single or multistrain and are presented in different formulations and doses, many as fermented milks and yoghurts. Efficacy is strain- and dose-specific and the UK availability of probiotics is low. Therefore, these guidelines only used evidence for those probiotics currently available in the UK.

Included studies and evidence statements

Five studies met the inclusion criteria and were evaluated as summarised in Table 7 (Bazzocchi *et al.*, 2002; Kim *et al.*, 2003, 2005; Guyonnet *et al.*, 2007; Agrawal *et al.*, 2009). Four RCTs and one observational study assessed the effects of single or multistrain probiotics on symptoms of IBS. These studies resulted in the following evidence statements:

4.1 There is limited weak evidence that *Bifidobacterium-lactis DN 173010* (Activia Danone; Danone, Paris, France) at a dose of two 125 g pots per day for a period of 4 weeks improves overall IBS-C symptoms, abdominal pain and urgency but not bloating, distension, flatulence or stool symptoms in secondary care (Guyonnet *et al.*, 2007; Agrawal *et al.*, 2009) SIGN 1−

4.2 There is limited weak evidence that a combination probiotic consisting of *Bifidobacterium* (*Bifidobacterium longum*, *Bifidobacterium infantis*, *Bifidobacterium breve*), *Lactobacillus* (*Lactobacillus casei*, *Lactobacillus bulgaricus*, *Lactobacillus plantarum*) and *Streptococcus* (*Streptococcus salivarius* sub sp *thermophilus*) (VSL#3) at a dose of two sachets (900 billion lyophilised bacteria) per day taken for at least 4 weeks reduces flatulence in IBS with bloating but not in IBS-D (Kim *et al.*, 2003, 2005) SIGN 1−

4.3 Four out of five studies reported no adverse events of taking probiotics in IBS (Bazzocchi *et al.*, 2002; Kim *et al.*, 2003, 2005; Agrawal *et al.*, 2009). One study reported two adverse events in the control group (Guyonnet *et al.*, 2007) SIGN 4

Practical considerations

Intervention using a probiotic to further improve IBS symptoms can be considered secondary to other second-line advanced dietary interventions (Fig. 1). There is insufficient good evidence to recommend a specific product. Individuals with IBS should be informed that, if one probiotic does not improve symptoms, they could trial a different product.

Individuals who choose to try probiotics should be aware that some products contain ingredients that may increase IBS symptoms (fructans, polyols, fructose and lactose). If a probiotic is found to be beneficial after 4 weeks of use, it can be continued, although the long-term effects are not known. Once a probiotic is stopped, the bacterial strain(s) will gradually cease to colonise the gut or reduce in numbers.

5.0 Elimination or empirical diets to improve irritable bowel syndrome symptoms

Empirical and elimination diets have traditionally been used to identify food intolerances in individuals with IBS.

Table 7 Studies included relating to probiotics

Study	Study design and *N*	Intervention + duration	Outcome on global symptoms	SIGN
Agrawal *et al.*, 2009	DB RCT 38 female IBS-C	Fermented milk containing *Bifidobacterium lactis DN-173 010* (17/21) versus control (nonfermented dairy product) (17/17) 2 × 125 g pots per day for 4 weeks	ITT global IBS symptom severity improved in the test group versus control ($P = 0.032$), size of effect: −0.5/5	1−
Bazzocchi *et al.*, 2002	Non-RCT 42 with IBS-D	VSL#3 3 g per day for 20 days	34/42 (81%) reported no IBS symptoms after treatment* and bowel movements decreased from 7.2 ± 2 to 2.1 ± 1.1 per day ($P < 0.002$)	2−
Guyonnet *et al.*, 2007	DB RCT 274 IBS-C	Fermented milk yoghurt containing *Bifidobacterium animalis DN-173 010* (135/137) versus control (heat treated yoghurt) (132/137) 2 × 125 g pots per day for 6 weeks	ITT no significant difference between groups for global IBS symptoms at 6 weeks*	1+
			Minor adverse events in 23/267 participants: 13 were from the probiotic arm and three stopped taking the product due to the adverse event compared to 10 from the control group, four stopped taking the placebo yoghurt	
			Serious adverse events in two participants from the control group	
Kim *et al.*, 2003	DB RCT 25 IBS-D	VSL#3 (12/12) versus placebo (starch powder) (12/13) 3 g per day for 8 weeks	ITT no significant difference between groups for global IBS symptoms at 8 weeks, 35% versus 7% improvement ($P = 1.0$)	1−
Kim *et al.*, 2005	DB RCT 48 IBS with bloating	VSL#3 (24/24) versus placebo (starch powder) (24/24) 3 g per day for 8 weeks (17) with protocol amendment to 4 weeks (31) due to poor recruitment	ITT significant improvement in flatulence for test group versus control ($P = 0.011$)*	1−

**P*-value for global bowel syndrome (IBS) symptoms not reported. DB, double-blind; IBS, irritable bowel syndrome; IBS-C, constipation predominant irritable bowel syndrome; IBS-D, diarrhoea predominant irritable bowel syndrome; ITT, intention-to-treat; *N*, number recruited; *n*, number completed; *n/N*, withdrawals; PP, per protocol analysis; RCT, randomised controlled trial; SB, single blind; SIGN, Scottish Intercollegiate Guidelines Network level of evidence.

There is no standard diet describing which foods or ingredients should be excluded. An exclusion diet excludes one or two foods suspected to be responsible for symptoms. An elimination or few foods diet includes a selection of low allergen foods, usually one type of meat, one cereal, two fruit and vegetables, a milk substitute and a fat source. An empirical diet excludes common food allergens associated with a specific condition when a dietary source is suspected but cannot be identified (British Nutrition Foundation, 2001).

An elimination diet should only be tried when individuals suspect multiple food intolerance and single food avoidance has not improved symptoms (Burden, 2001).

Included studies and evidence statements

Six studies met the inclusion criteria and were evaluated as summarised in Table 8 (Petitpierre *et al.*, 1985; Nanda *et al.*, 1989; Piccinini *et al.*, 1990; Hawthorne *et al.*, 1991; Parker *et al.*, 1995; Stefanini *et al.*, 1995). Two were RCTs comparing an elimination diet to sodium chromoglicate and the remaining four were intervention studies using an empirical or elimination diet followed by food challenge. These studies resulted in the following evidence statements:

5.1 There is moderate weak evidence that individuals with IBS, particularly IBS-D, may benefit from an elimination or empirical diet. There is no direct trial evidence relating specifically to IBS-C or IBS-M (Petitpierre *et al.*, 1985; Nanda *et al.*, 1989; Piccinini *et al.*, 1990; Hawthorne *et al.*, 1991; Parker *et al.*, 1995; Stefanini *et al.*, 1995) SIGN 2−

5.2 There is moderate weak evidence that the initial stage of the elimination or empirical diet should be followed for 2–4 weeks before food re-introduction is commenced (Petitpierre *et al.*, 1985; Piccinini *et al.*, 1990; Hawthorne *et al.*, 1991; Stefanini *et al.*, 1995) SIGN 2−

Table 8 Studies included relating to elimination or empirical diets

Study	Study design and *N*	Intervention + duration	Outcome on global symptoms	SIGN
Hawthorne *et al.*, 1991	Intervention 38 IBS	Empirical diet for 2 weeks followed by food challenge	18 improved on empirical diet and trigger foods for IBS symptoms were: wheat, milk, corn, cheese, coffee, rye, barley, oats, brassica, egg, tea, onion, yeast, potato, cocoa, peas, banana*	2–
Nanda *et al.*, 1989	Intervention 189 IBS	Empirical diet for 3 weeks followed by food challenge	91 (48%) improved on empirical diet and challenge identified tigger foods for IBS symptoms: 35% onion, cheese, 32% milk, 30% wheat, 28% chocolate, 25% yoghurt, butter, 24% coffee, 23% eggs, 18% rye, citrus, nuts, 15% potato, 13%, barley, 12% oats, 11% corn, 9% alcohol, 8% fruit, 6% vegetables, yeast, 4% beef, 2% fish, salad, lamb, pork, spices, soya, additives, saccharin*	2–
Parker *et al.*, 1995	Intervention 253 IBS	Phase 1: empirical diet (200/253)	100 had improved IBS symptoms in phase 1 and 39 had improved IBS symptoms in phase 2. Trigger foods for IBS symptoms in: Phase 1: wheat, milk, corn, oats, coffee, egg, tea, citrus, onion, chocolate, potato; Phase 2: wheat, milk, coffee, potato, corn, onion, beef, oats, cheeses, white wine*†	2+
			Phase 2: elimination diet (96/129)	
Petitpierre *et al.*, 1985	Intervention 24 IBS	Empirical diet for 3 weeks followed by food challenge	Trigger foods for IBS symptoms: 20% milk, 13% wheat, 8% eggs, nuts, tomato, potato, preservatives, 4% banana, cereal, tuna, white wine*	2–
Piccinini *et al.*, 1990	RCT CO 42 IBS-D	Elimination diet versus disodiumchromoglycate for 3 weeks with >30 days washout	28/42 had improved symptoms on the elimination diet compared to 25/42 on disodiumchromoglycate*	1–
Stefanini *et al.*, 1995	RCT 409 IBS-D	Elimination diet (171/209) versus cromolyn sodium (175/200) for 1 month	Both groups showed a significant improvement in IBS symptoms from baseline to 1 month ($P < 0.001$) but comparisons between groups are not presented. Trigger foods for IBS symptoms were identified in 67% of the elimination diet group with 48% peas and beans, 46% milk, 26% nuts, hazelnuts, peanuts, 19% egg*	1–

**P*-value for global irritable bowel syndrome (IBS) symptoms not reported.

†Phase 2: unusual triggers noted: pork, gammon, bacon, dried fruit, ham, tinned fish in soya oil, smoked fish, banana, pea, cauliflower, cabbage, bell pepper, broccoli, sugar, fried food, liver, lamb, turkey, prawn, apple, apple juice, grape, grape juice, all fruit, lettuce, parsnip, cucumber, spices, rice, high fibre food.

CO, cross-over; IBS, irritable bowel syndrome; IBS-C, constipation predominant irritable bowel syndrome; IBS-D, diarrhoea predominant irritable bowel syndrome; RCT, randomised controlled trial; SIGN, Scottish Intercollegiate Guidelines Network level of evidence.

5.3 There is limited weak evidence that, when following an elimination or empirical diet, at least three trigger foods are usually identified. The most common of these are wheat, milk, coffee, eggs and potatoes (Petitpierre *et al.*, 1985; Nanda *et al.*, 1989; Hawthorne *et al.*, 1991; Parker *et al.*, 1995) SIGN 2–

5.4 There is limited weak evidence that, if there is no symptom improvement after the initial 2–4 weeks of an elimination or empirical diet and foods being consumed are not suspected as a trigger of IBS symptoms, then food is unlikely to be a contributing factor (Nanda *et al.*, 1989; Hawthorne *et al.*, 1991; Parker *et al.*, 1995) SIGN 2–

Practical considerations

Elimination and empirical diets usually take 3–4 months to complete, including the re-introduction phase. An assessment of whether this dietary treatment is appropriate for the individual is required and, if this is not the case, the patient should be referred back to the referring clinician for further treatment options. Medical management may be needed for existing or suspected food allergy. If there is no symptom improvement within 2–4 weeks of the initial phase, it may be necessary to remove other potential dietary triggers before a decision is made that food intolerance is not causative. Trigger

foods are likely to be consumed regularly and often in large quantities.

After the initial exclusion period, a period of 48 h should be left between food challenges and an awareness that a reaction may be more severe following food avoidance is necessary. If an IBS symptom develops, the trigger food should be removed and no challenge with a new food should be made until the symptoms have resolved. A review is required after completion of the food reintroduction phase (usually 6 months) to assess the nutritional adequacy of the diet.

Discussion

These guidelines provide evidence statements, recommendations and practical considerations for dietitians on the effective dietary management of IBS in adults and will improve evidence-based practice. Because much of the evidence is of poor quality and limited by the lack of suitable papers for inclusion, research recommendations were also proposed.

Adequately powered and well designed RCTs, with long-term follow-up, should focus on the clinical effectiveness and/or safety of dietary treatments using objective symptom assessment and taking into consideration IBS-subtype and setting (primary and secondary care). Dietary treatments include linseeds, fermentable carbohydrates, probiotics, prebiotics and synbiotics, and elimination or empirical diets. Furthermore, the prevalence of lactose and fructose malabsorption in specific countries should be identified taking into consideration individuals with and without IBS, as well as ethnicity. In addition, the assessment of the cost effectiveness of hydrogen breath tests in the management of lactose and/or fructose malabsorption and the development of comprehensive nutritional data on the fermentable carbohydrate content of foods are important considerations.

The IBS algorithm (Fig. 1) encompasses a new chronological pathway for the dietary management of IBS considering clinical assessment alongside dietary and lifestyle factors within a three-tiered management approach. Within some healthcare settings, access to novel interventions (e.g. reducing fermentable carbohydrate intake) may be limited as a result of financial and dietetic manpower restrictions. In such circumstances, current practice using NICE guidelines (NICE, 2008) is the next most suitable dietary intervention to employ.

Altering the intake of fermentable carbohydrates is an emerging dietary treatment for IBS management, with evidence for its clinical effectiveness only coming from Australia and the UK (Gibson & Shepherd, 2010; Staudacher *et al.*, 2011). For the purpose of these guidelines, the focus of the question was restricted to the effects of fermentable carbohydrates on abdominal bloating as a result of its high prevalence and ranking as the most worrying symptom in IBS (Houghton *et al.*, 2006). However, fermentable carbohydrates induce other IBS symptoms, such as loose stools and flatulence as a result of their osmotic activity and their being readily available for colonic bacterial fermentation (Barrett *et al.*, 2010; Ong *et al.*, 2010). Future updates will consider all IBS symptoms in relation to fermentable carbohydrates.

The Gastroenterology Specialist Group of The British Dietetic Association is responsible for updating the BDA IBS guidelines every 3 years. They were originally developed specifically for UK-based dietitians because no formally accepted national dietary guidelines existed previously. This resulted in the question on probiotics being focused on the evidence for UK available probiotics, which thus has limited the applicability of the question internationally. In light of the increased accessibility of probiotics that are currently available only outside the UK, future updates will take into consideration studies on all the available probiotics.

In summary, these guidelines, which have been developed for registered dietitians, offer an evidence-based dietary treatment pathway for adults with IBS. They will increase standardisation in clinical practice, thus improving patient outcomes in relation to the dietary management of this disorder.

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Conflicts of interest, sources of funding and authorship

All the authors are practicing dietitians who have worked with adults with IBS. As such, they have experience and a professional interest in these guidelines. All members of the IBS-DGDG signed conflicts of interest forms annually during the development of these guidelines. Signed copies from December 2009 are retained by MCEL and can be inspected by any interested party. The project was part-funded by the General Education Trust of The British Dietetic Association. All authors contributed to the development of the evidence statements, recommendations and practical considerations and agreed the final document. YAM and MCEL were integral to the writing of the final publication. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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Supporting information

Additional Supporting Information may be found in the online version of this article.

Data S1. UK evidence-based practice guidelines for the dietetic management of irritable bowel syndrome (IBS) in adults. Professional guideline by The British Dietetic Association, Sept 2010.

Data S2. Appendices A-G for UK evidence-based practice guidelines for the dietetic management of irritable bowel syndrome (IBS) in adults. Professional guideline by The British Dietetic Association, Sept 2010.

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