

Efficacy of an Irritable Bowel Syndrome Diet in the Treatment of Small Intestinal Bacterial Overgrowth Treatment: A Narrative Review [†]

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Abstract: Introduction: Small Intestinal Bacterial Overgrowth (SIBO) is highly prevalent in Irritable Bowel Syndrome (IBS). An eradication of bacterial overgrowth with antibiotics is the first-line treatment. However, focusing only on the antimicrobial effect, without taking care to improve lifestyle factors, especially dietary patterns, may not yield satisfactory results and may even predispose to intestinal microbiota dysfunction. **Aim:** The objective of this study is to determine whether the current recommendations regarding nutrition in IBS are suitable for patients with SIBO. **Methods:** A narrative literature review was carried out using databases including PubMed, ScienceDirect and Google Scholar to investigate the current recommendations regarding the necessary elements of lifestyle and nutrition therapies in SIBO treatment. **Results:** Recent studies indicate that dietary manipulation may have a role in alleviating SIBO gastrointestinal symptoms. A low FODMAP-diet proposed for IBS may regulate symptoms of the digestive system, but there is no reliable data to determine whether this specific elimination diet will be effective in patients with SIBO. Long-term reduction of prebiotics (FODMAPs) may result in unfavorable changes in the composition of the gut microbiota, promoting dysbiosis. Supplementation with soluble fiber can alleviate the symptoms of diarrhea and constipation in IBS and SIBO. Targeted probiotic therapy with the use of well-characterized microbial strains may increase the effectiveness of antibiotic treatment, regulate bowel movements and improve the quality of life of patients with disturbed intestinal microbiota. In patients with SIBO a lower frequency of migrating motor complex (MMC) is acknowledged, which are responsible for cleansing the gastrointestinal tract from food debris and excess bacteria. Therefore optimal dietary patterns play a key role in the treatment of SIBO. **Conclusions:** Based on currently available literature, the potential efficacy of the IBS diet in SIBO is largely hypothetical. Future research is needed to characterize a specific diet for the treatment of SIBO.

Keywords: microbiota; dysbiosis; IBS; SIBO; FODMAP; probiotics; prebiotics; MMC

1. Introduction

The gut microbiota represents an essential human organ with a variety of beneficial functions for the host. Disturbances in the composition of gut microbiota, defined as dysbiosis, may predispose to the development of Small Intestinal Bacterial Overgrowth (SIBO) [1]. The diagnosis of SIBO is performed via invasive or non-invasive methods, which indicate an abnormal amount of bacterial or methanogenic load in the proximal or distal part of the small intestine [2]. SIBO is characterized by non-specific gastrointestinal

symptoms, similar to Irritable Bowel Syndrome (IBS), whereby changes in bowel movements are seen [3]. It has been shown that up to 78% of patients with IBS also test positive for SIBO [4]. Fortunately, the optimal nutritional management of IBS has already been established [5]. This includes implementing a low FODMAP diet, supplementing with probiotics and prebiotics, improving lifestyle factors and avoiding harmful products may aggravate IBS symptoms [6,7]. Although SIBO has been studied for a long time and the eradication of bacterial overgrowth with antibiotics is recognized as the first-line treatment, little is known about the optimal diet and lifestyle for SIBO. The objective of this study is to determine whether the current recommendations regarding nutrition in IBS would be suitable for patients with SIBO.

2. Methods

A comprehensive search of PubMed, ScienceDirect and Google Scholar was conducted from 2012 to 2022 to identify suitable literature. The search strategy included the following terms: (low fodmap OR high fodmap)AND (clinical trial OR randomized controlled trail OR cross-sectional study OR crossover study OR retrospective study OR intervention study) AND (ibs OR irritable bowel syndrome) AND (sibo OR small intestinal bacterial overgrowth) AND (probiotic OR monoprobiotic OR bacterial strain) AND (fiber OR soluble fiber OR psyllium OR inulin OR phgg) AND (mmc OR migrating motor complex) AND (mindful eating or mindfulness training). Abstracts and titles of relevant articles were screened and only full-length papers with quantitative statistical analyses were included into this narrative review. Conference proceedings, abstracts, meta-analyses were not included. Studies based on children, pregnant woman, animal or in-vitro experimentation, poliprotiotics treatment or reported in a non-English language were excluded. Studies with results on Inflammatory Bowel Disease, Ulcerative Colitis, colon cancer, colorectal cancer or Celiac Disease were also excluded. Ultimately the review was limited to studies conducted in patients with SIBO, IBS and Functional Gastrointestinal Disorders (FGIDs) and healthy people.

3. Results and Discussion

The initial search strategy yielded 65 articles and following a comprehensive review, 34 studies comprised of 25 randomized controlled trials, 5 clinical trials, 2 cross-sectional studies, 1 retrospective study and 1 pilot dietary intervention study were analyzed for inclusion into the narrative review. Analysis of these findings is presented under the following four categories: Low FODMAP Diet, Fiber, Monoprobiotics and Mindful Eating.

3.1. Low FODMAP Diet

Altogether, twelve studies identified potential connections between a low FODMAP diet and the microbiota profile [8–19]. The majority of papers compared the low FODMAP diet in IBS patients to traditional dietary recommendations, habitual diets or a high FODMAP diet. None of the studies evaluated the impact of this diet in SIBO patients. Three studies investigated the relationship between probiotics or prebiotics in combination with the low FODMAP diet on the gut microbiota [9,12,17]. Nine authors proposed that implementation of a low FODMAP diet for 4 to 9 weeks may adversely decrease the abundance of *Actinobacteria*, especially *Bifidobacterium* [8–15,17], while co-administration of a probiotic and prebiotic [fructo- oligosaccharides (FOS) but not B-galactooligosaccharides (B-GOS)] with the low FODMAP diet may reverse these changes [9,12,17]. Contrary to those studies, one paper found an inverse correlation, suggesting an increase in the quantity of *Bifidobacterium* and *Lactobacillus*, however this was following a low FODMAP and gluten free diet [19]. Other studies showed that a reduction in FODMAPs foods can significantly increase saccharolytic *Bacteroides* and nonsaccharolytic taxon *Bilophilia*[10,11]. *Bilophilia*, a hydrogen sulfide-producing species, may be likely involved in the pathogenesis of Hydrogen Sulfide SIBO. Halmos et al. [13] suggested an average reduction of 47% in the total

bacterial load following adherence to the low FODMAP diet. Furthermore, a study conducted by Bennet et al. [14] revealed that 42% of IBS patients scored higher on the Dysbiosis Index after 4 weeks of the low FODMAP diet. Four authors did not find a reduction in the diversity of microbiota [10,13,15,18]. Only two of the included studies focused on measuring exhaled gases in breath tests. McIntosh et al. [15] demonstrated only a slight depletion in hydrogen production in the low FODMAP group compared with the high FODMAP group, whereas Patcharatrakul et al. [16] noticed that post-prandial hydrogen breath production was significantly lower in a low fodmap group in comparison to commonly recommended diet. Elimination of foods high in fermentable oligo-, di-, and monosaccharides, and polyols (FODMAPs) may lessen lingering IBS symptoms and improve quality of life in IBS patients [20]. However it is postulated that prolonged restriction of FODMAP foods may be linked with undesirable alterations in gut microbiota [21,22]. Although SIBO is associated with the disruption of microbial composition, it remains uncertain whether this proposed nutritional model is helpful for patients with SIBO.

3.2. Monoprotobiotics

The impact of mono-strain probiotic supplementation on the modification of gut microbiota was assessed in eleven studies [23–33]. Only one study by García-Collinot et al. [23] included patients with SIBO. The results of this paper concluded that supplementation with *Sacharomyces boulardii* (CNCM I 745) in SIBO patients with systemic sclerosis was associated with significantly higher eradication rates and a decline in exhaled hydrogen as compare to metronidazole therapy alone [23]. The nine remaining studies were carried out in patients with IBS [27,29–33], constipation [25,26,28] and healthy individuals [24]. Hydrogen or methane breath tests were only measured in three papers [23,24,26]. Administration of *Bifidobacterium Infantis* 35624 and *Lactobacillus reuterii* (DSM 17938) found no association with changes in hydrogen production, and only *L. reuterii* decreased methane production [24,26]. In eight studies, authors observed significant symptom relief with *B. coagulans* LBSC(DSM17654) [33], *B. coagulans* (MTCC 5856) [27], *B. coagulans* Unique IS [28], *L. plantarum* 299v (DSM 9843) [29], *S. cerevisiae* CNCM I-3856 [30], *S. boulardii* CNCM I 745 [31] and *B. animalis* subsp. *lactis* BB-12[25] following 4-8 weeks of treatment. Furthermore, supplementation with *L. paracasei* HA-196 or *B. longum* R0175 appeared to ameliorate quality of life based on the IBS-QOL score [31]. In particular the *L. paracasei* group required fewer rescue medications in comparison with the placebo group [32]. Khalighi et al. [34] also supports improved bacterial eradication in SIBO patients, however this study looked at the co-administration of an antibiotic with a symbiotic (*Bacillus Coagulans* Unique IS-2 and FOS for 15 days) rather than a monoprotobiotic. Similar conclusions were drawn in a comprehensive meta-analysis and systematic review by Zhong et al. [35]. Monoprotobiotic therapy is associated with regulating gut motility, may provide effective relief of bloating, abdominal pain, diarrhea or flatulence and may improve stool consistency. Based on these studies, monoprotobiotics may have a favorable role in preventing the progression of symptoms in SIBO, however evidence is still lacking.

3.3. Fiber

In total, seven studies analyzed the association between fiber supplementation and the impact on the gutmicrobiome [36–42]. Supplementing with soluble fiber was related to positive changes in the bacterial composition of the gut microbiota [37,39,41,42]. Moreover, four authors observed that adding psyllium husk or Partially Hydrolyzed Guar Gum (PHGG) to a regular diet may improve IBS symptoms such as abdominal pain, bloating orgasses, as well asimprovestool consistency and frequency [37–40]. Switching from a high fiber diet to low fiber diet (<11 g/1000 cal) in 16 healthy volunteers for 7 days was associated with thedevelopment of gastrointestinal symptoms in every participants of the study. Moreover, SIBO was diagnosed in two subjects after this short-term intervention with a low fiber diet [36]. Similar results were found in not included studies [43,44]. In

accordance, Garg [44] concluded that the intake of 25g of psyllium husk with 500 mL of water for 12 weeks resulted in a major relief of IBS symptoms. However, Oskouie et al. [43] presented that IBS was more prevalent in individuals with a low intake of dietary fibre. These studies support that increasing the intake of fibre, in particular soluble fiber, may yield satisfactory results in SIBO patients.

3.4. Mindful Eating

The migrating motor complex (MMC) acts as a “gastrointestinal keeper” and is responsible for cleansing the gastrointestinal tract from food debris and sweeping excess bacteria into the colon [45]. In one paper, patients with SIBO were reported to have a lower frequency of Phase III MMCs, thus acknowledging it as a risk factor for SIBO [45]. Mindful eating, defined as appropriate breaks between meals, including the omission of snacking, might be a key element in the prevention and treatment of SIBO. Based on four included studies [46–49], participants who were paying attention to meal regularity, chewing sufficiently, consuming slower and focusing more on when and how to eat, rather than what to eat, showed a decrease in IBS symptoms and in the probability of developing IBS and FGIDs. However, in one study the associations disappeared after adjustment for total confounding variable [48]. These results have not been replicated in the SIBO population.

4. Conclusions

This narrative review suggested that there is a favourable association with a short-term low FODMAP diet, monoprobiotics and fiber supplementation and mindful eating on the gut microbiome, especially in IBS patients. Applying these recommendations to the treatment of SIBO is inconclusive due to a lack of research including SIBO patients in the studies. The potential efficacy of the IBS diet in SIBO is largely hypothetical and future research is needed to characterize specific dietary recommendations for the treatment of SIBO.

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