

Analysis of Risk Factors and Intervention Strategies for Irritable Bowel Syndrome

Yiming Chen *

School of Food and Health, Beijing Technology and Business University, Beijing, China

* Corresponding Author Email: LokENTHe16Th@outlook.com

Abstract. Irritable Bowel Syndrome (IBS) is a common functional gastrointestinal disorder, with a global prevalence of approximately 10%–20% and a prevalence of about 6% in community populations in China. It is primarily characterized by recurrent abdominal pain and changes in bowel habits, significantly impacting patients' quality of life. The pathogenesis of IBS is complex, involving interactions among multiple factors such as genetic susceptibility, psychosocial factors, dietary influences, and disruptions in the gut microbiota. Currently, the effectiveness of drug treatment is limited, and non-drug interventions are receiving increasing attention. This article systematically reviews the main risk factors and intervention strategies of IBS, with a focus on analyzing the roles of diet, psychological state, and gut microbiota in the occurrence and development of the disease. The study found that a high Fermentable Oligosaccharides, Disaccharides, Monosaccharides and Polyols (FODMAP) diet, gluten sensitivity, psychological problems such as anxiety and depression, and gut microbiota imbalance all significantly affect IBS symptoms. Effective intervention measures include a low FODMAP diet, a gluten-free diet, cognitive behavioral therapy, etc., which can significantly relieve symptoms and improve the quality of life. Emerging therapies such as Fecal Microbiota Transplantation (FMT) have shown promising potential in alleviating symptoms and emotional disturbances in patients with diarrhea-predominant (IBS-D), indicating that modulating the gut microbiome represents a crucial direction for future treatment. Individualized and multi-target comprehensive management will be the key to improving the prevention and treatment effect of IBS.

Keywords: IBS, dietary factors, psychological factors, dietary intervention, fecal microbiota transplantation.

1. Introduction

Real-world background: Irritable Bowel Syndrome (IBS) is a highly prevalent functional gastrointestinal disorder globally. Its main clinical features include recurrent abdominal pain related to defecation, accompanied by changes in bowel habits or abnormal fecal characteristics. The disease has a chronic course with recurrent symptoms, which not only significantly reduces the quality of life of patients but also brings a heavy medical burden and socio-economic costs. Statistics show that the global prevalence of IBS ranges from 10% to 20%, and the prevalence in the community population in China is approximately 6% [1,2]. According to the Rome III diagnostic criteria, IBS can be classified into diarrhea-predominant (IBS-D), constipation-predominant (IBS-C), mixed (IBS-M), and unsubtyped (IBS-U). Among them, the diarrhea-predominant type accounts for about 23% of the total number of patients [3]. Currently, the clinical management of IBS still faces significant challenges. Due to its complex etiology and incompletely understood pathogenesis, there is a lack of specific treatments. Available drug options are limited and vary in efficacy, with most therapeutic approaches providing only temporary symptom relief. Most treatment plans can only relieve symptoms temporarily. Therefore, preventing the occurrence of IBS and effectively controlling its symptoms have become important issues that need to be addressed urgently in the field of gastroenterology. Against this background, non-pharmacological intervention strategies, especially dietary and lifestyle adjustments, have increasingly attracted the attention of researchers and clinicians.

Literature background: Previous literature has shown that dietary factors are one of the important risk factors for the occurrence and symptom induction of IBS. Most IBS patients feel that certain foods can trigger or exacerbate their symptoms, such as high-fermentable oligosaccharides,

disaccharides, monosaccharides, and polyols (FODMAP) foods, spicy foods, or high-fat diet, etc. Multiple studies have reported that approximately two-thirds of patients can achieve significant symptom relief through dietary adjustments (such as a low FODMAP diet) [4,5]. This finding has prompted an increasing number of patients and healthcare providers to regard dietary intervention as an important part of irritable bowel syndrome (IBS) management.

In addition to dietary factors, the pathogenesis of IBS involves interactions among multiple elements, primarily including genetic susceptibility, psychosocial factors (such as stress, anxiety, and depression), and disruptions in the gut microbiota. In recent years, the role of the gut microbiota in the pathophysiological mechanism of IBS has attracted particular attention. Research has shown that patients with IBS often have abnormalities in the composition and function of the gut microbiota. For example, there is a decrease in microbiota diversity, an increase in potential pathogenic bacteria, and a decrease in probiotics. This finding provides a theoretical basis for microbiota-based intervention strategies. Fecal microbiota transplantation (FMT), as an emerging treatment method, can transplant the functional microbiota of healthy donors into the patient's intestine to reconstruct a normal microbial ecosystem. It has achieved remarkable results in fields such as recurrent *Clostridioides difficile* infection and is gradually being explored for the treatment of IBS. Although existing studies have initially revealed the associations among diet, gut microbiota, and IBS symptoms, most of the literature still focuses on the exploration of single factors and lacks a systematic analysis of the interactions among multiple risk factors (such as diet, psychology, and microbiota), especially the differential research for different subtypes of IBS. In addition, there is no consensus on the application effects and mechanisms of new intervention strategies such as FMT in IBS, and their long-term safety and effectiveness also need further verification.

Significance of this study: Therefore, this study aims to systematically sort out the main risk factors of irritable bowel syndrome (IBS), focus on analyzing the associations between factors such as diet, psychology, and gut microbiota and the occurrence and development of IBS, and further explore the effects and mechanisms of targeted intervention strategies (especially dietary adjustments and fecal microbiota transplantation, FMT) on symptom improvement.

Research objectives: By integrating existing evidence and clinical data, this study expects to clarify the internal relationships between key risk factors and intervention measures, provide a scientific basis for formulating individualized and precise IBS prevention and management plans, and ultimately improve the clinical outcomes and quality of life of patients.

2. Analysis of IBS Risk Factors

2.1. Genetic Factors

Epidemiological surveys have shown that there is a family aggregation phenomenon in IBS. A cross-sectional study in Saudi Arabia found that the proportion of IBS patients (80%) with a positive family history (referring to relatives within three generations diagnosed with IBS) was significantly higher than that of the control group (60%). Logistic regression analysis showed that a family history of IBS (FH-IBS) was one of the most common risk factors among IBS patients [6]. Fu et al studied 75 pediatric patients with a positive FH-IBS and 176 pediatric patients with a negative FH-IBS. They found that children with FH-IBS were more likely to develop psychological comorbidities (41% vs 23%, $P = 0.003$), and were more likely to receive psychological counseling (49% vs 23%, $P < 0.001$) and antidepressant treatment (36% vs 25%, $P < 0.001$) [7]. This indicates that genetic factors play a key role in the development of IBS.

2.2. Psychosocial Factors

With the progressive advancement in basic research on functional gastrointestinal disorders and the accumulating clinical experience in the psychosomatic integration of digestive medicine, there is a deepening understanding of the etiology and pathogenesis of Functional Bowel Disorders (FBD).

The significant role of psychosocial factors in the onset and progression of FBD is increasingly garnering attention. The important role of psychosocial factors in the occurrence and development of FBD has increasingly attracted people's attention. Unfavorable psychosocial factors induce and promote the occurrence and development of FBD, while the recurrent attacks of FBD symptoms further aggravate the anxiety and depression of patients, thus forming a vicious cycle. As a result, the phenomenon of FBD accompanied by psychosocial disorders is very common in clinical practice. Studies have found that the occurrence and development of FBD, especially irritable bowel syndrome (IBS), are closely related to psychosocial factors. Common psychosocial disorders include psychological abnormalities such as irritability, neuroticism, anxiety, and depression. Approximately 50% - 90% of IBS patients have varying degrees of various forms of psychosocial disorders such as generalized anxiety, depression, social phobia, and somatization disorder. Among them, the most prominent manifestations are anxiety or depression [8]. Zamani et al. conducted a meta-analysis on the psychosomatic factors of IBS patients. The results showed that the prevalence rates of anxiety and depression in IBS patients were 39.1% and 28.8% respectively. Compared with the healthy control group, the risk of anxiety or depression in IBS patients increased by about 3 times [9]. Hu et al.'s meta-analysis of different subtypes of IBS patients showed that compared with the healthy control group, the prevalence rates of anxiety and depression in different subtypes of IBS patients were significantly higher, and those of patients with functional constipation were particularly prominent [10]. It can be seen that the prevalence of mental and psychological disorders in patients with functional bowel disorders (FBD) is relatively high, and attention should be paid to its role in the occurrence of FBD symptoms.

2.3. Dietary Factors

Dietary factors can be mainly divided into three parts, namely traditional diet, low FODMAPs diet, and gluten-free diet. The traditional dietary advice is mainly a healthy diet. Patients with irritable bowel syndrome often report that alcohol, caffeine, spicy foods, and high-fat foods can trigger gastrointestinal symptoms. Therefore, a healthy diet for IBS patients includes restricting the intake of alcohol, coffee and/or tea, and fat, evaluating the components in spicy foods related to IBS symptoms, adjusting the intake of dietary fiber, and ensuring sufficient fluid intake. The traditional dietary advice is considered the first-line dietary treatment for IBS.

FODMAPs have the characteristics of good osmotic activity and low absorption. They can increase the osmotic pressure in the intestinal lumen, increase the volume of water in the intestine, promote intestinal peristalsis and transit, and lead to osmotic diarrhea. Undigested FODMAPs are decomposed and fermented by the intestinal flora, increasing gas production.

Approximately 10% of the population reports being sensitive to gluten-containing foods and states that gluten-containing foods can cause IBS-like symptoms. Gluten proteins are mainly present in foods such as wheat, barley, and oats. The grain contains about 10% - 20% protein, of which 80% is gluten. Gluten can reduce the expression of tight junction proteins in cells, affect the intestinal barrier function, and also participate in the formation of inflammatory factors and the intestinal inflammatory response, thereby inducing IBS-like symptoms [11].

3. IBS Intervention Strategies

3.1. Dietary Intervention

In terms of the traditional diet: First, limit alcohol intake as it can affect gastrointestinal motility, absorption, and mucosal permeability [12]. Second, limit caffeine intake—present in beverages like coffee and tea—as it can easily cause chronic gastrointestinal tract irritation, increase gastric acid secretion, and enhance colonic motility activity; third, partially limit spicy foods, since capsaicin (an active ingredient in chili peppers) can stimulate the transient receptor potential vanilloid 1 (TRPV1), lower the pain threshold, and thus cause discomfort such as abdominal pain; fourth, reduce fat intake because it can stimulate the gastrocolic reflex (a reaction amplified in patients with irritable bowel

syndrome, or IBS), and consuming high-fat foods may aggravate discomfort symptoms in IBS patients; fifth, adjust dietary fiber intake: dietary fiber is divided into soluble fiber (e.g., psyllium husk, plantain) and insoluble fiber (e.g., rice bran, wheat bran), and a meta-analysis found that soluble fiber intake significantly improves IBS patients' symptoms, whereas insoluble fiber offers no obvious benefits and may even cause bloating and abdominal discomfort.

The low FODMAP diet should be implemented under the guidance of nutritionists and experts. Its implementation process can be divided into three stages. The first stage is the "restriction period", during which all foods rich in FODMAP are strictly restricted for 4 - 8 weeks. The second stage is the "reintroduction period", during which FODMAP foods are gradually reintroduced to determine the tolerance level to different foods. The third stage is the "individualization period", during which different eating habits are selected according to personal tolerance levels and adhered to in the long term.

Compared with the low FODMAP diet, patients may be more inclined to the convenience of the gluten-free diet (GFD). For GFD, only several types of food need to be removed, while for the low FODMAP diet, multiple categories of food need to be removed during the restrictive phase. In addition, during the long-term "individualized" phase of the low FODMAP diet, the main focus is on reducing the intake of fructans. Therefore, for patients themselves, adopting GFD is more convenient and easier to accept. However, currently in clinical practice, most clinicians still tend to recommend the low FODMAP diet rather than GFD. GFD also has the problem of nutritional deficiencies, which can affect the patient's energy and trace element intake. However, these nutritional deficiencies are not unique to GFD, and nutritional deficiencies may also occur in general eating habits.

3.2. Psychological Therapy Intervention

The onset of IBS is closely related to psychological state. Psychosocial factors affect the severity of symptoms and quality of life. Therefore, cognitive behavioral therapy (CBT) has become an important part of the comprehensive management strategy for IBS. CBT aims to change the perception and response to symptoms and help patients establish healthy coping strategies [13]. Gut-directed therapy focuses on regulating gut function through relaxation training and mindfulness practice, focusing on regulating intestinal function and providing a non-pharmacological approach to improving IBS symptoms [14]. The development of psychological treatment methods has attracted the attention of the clinical and scientific research fields. In addition to CBT and gut-directed therapy, patient education and support groups are also important methods for managing psychological burden. Mindfulness meditation and relaxation training can relieve physical tension and mental stress by regulating attention, which may help relieve IBS symptoms [15].

3.3. FMT Treatment

Similar to probiotics and antibiotics, FMT has been proven to restore a balanced microbiota and is a potential treatment option for gut microbiota dysbiosis. Two different clinical trials have found that fecal microbiota transplantation (FMT) has a positive impact on irritable bowel syndrome (IBS) symptoms: (1) The randomized controlled trial by Guo et al. evaluated the therapeutic effect of FMT on IBS-D patients with comorbid anxiety and depression. Compared with the control group, in the experimental group, the severity of IBS-D was reduced, the fecal type changed (the quantity almost dropped to half of the original), and the anxiety and depression scores decreased (by 55% and 21% respectively). The FMT therapy improved the bacterial α -diversity, and the relative abundances were higher in the FMT group (51.00% and 46.00%) than in the control group (48.00% and 39.00%) 12 weeks after FMT treatment [16]. (2) A randomized controlled trial investigating the differences in the responses of severe and moderate IBS patients to FMT found that FMT could relieve the abdominal symptoms and fatigue of severe and moderate IBS patients and improve their quality of life. Compared with moderate IBS patients, severe IBS patients had a higher response rate to FMT, and more significant improvements in fatigue levels and quality of life.

4. Conclusion

In conclusion, irritable bowel syndrome (IBS) is a complex functional gastrointestinal disease involving multiple factors. Its occurrence and development involve the interaction of multiple mechanisms such as genetic susceptibility, psychosocial factors, dietary influences, and gut microbiota disorders. This article systematically reviews the main risk factors of IBS, emphasizing the key roles of diet (such as high-FODMAP foods, gluten sensitivity), psychological state (such as anxiety, depression), and gut microbiota imbalance in symptom induction and persistence. At the same time, the analysis of non-pharmacological intervention strategies shows that a low FODMAP diet, gluten-free diets, and psychological treatments (such as cognitive behavioral therapy and mindfulness training) have shown significant effects in alleviating symptoms and improving quality of life. Notably, fecal microbiota transplantation (FMT), as an emerging therapy, has demonstrated potential in simultaneously improving symptoms and emotional disorders in IBS-D patients in some clinical trials, suggesting that regulating the intestinal microecology may be an important future treatment direction.

Looking ahead, it is essential to further deepen research on the pathogenesis of IBS, especially the dynamic interactions among nerves, immunity, and microorganisms in the "gut-brain axis", such as how psychological stress affects intestinal motility and visceral sensitivity through neuropeptide receptors or inflammatory factors, providing theoretical support for precise intervention. At the same time, promoting the development of personalized medicine is crucial - combining patients' microbiota profiles, genetic backgrounds, symptom subtypes, and psychological states to formulate targeted intervention plans, such as customizing probiotic supplements for specific missing bacterial genera or adopting a comprehensive management model combining FMT and psychological therapy. With the application of multi-omics technologies and artificial intelligence, it is expected that precise classification and dynamic regulation of IBS will be achieved in the future, truly moving towards a new paradigm of individualized and full-cycle health management.

References

- [1] Sperber A D, Bangdiwala S I, Drossman D A, et al. Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome Foundation global study. *Gastroenterology*, 2021, 160(1): 99-114.e3.
- [2] Fang X C, Ke M Y. Prevalence and epidemiological survey of irritable bowel syndrome in China: historical status. *Chinese Journal of Practical Internal Medicine*, 2016, 36(9): 753-755.
- [3] Lovell R M, Ford A C. Global prevalence of and risk factors for irritable bowel syndrome: a meta-analysis. *Clinical Gastroenterology and Hepatology*, 2012, 10(7): 712-721.e4.
- [4] Böhn L, Störsrud S, Törnblom H, Bengtsson U, Simrén M. Self-reported food-related gastrointestinal symptoms in IBS are common and associated with more severe symptoms and reduced quality of life. *American Journal of Gastroenterology*, 2013, 108(5): 634-641.
- [5] Eswaran S, Muir J, Chey W D. Fiber and functional gastrointestinal disorders. *American Journal of Gastroenterology*, 2013, 108(5): 718-727.
- [6] Alqahtani N, Mahfouz M. The prevalence and risk factors of irritable bowel syndrome in Saudi Arabia in 2019. *International Journal of Preventive Medicine*, 2022, 13(1): 1.
- [7] Fu Y, Thomas R, Cares K. Influence of family history on children with irritable bowel syndrome. *Journal of Pediatric Gastroenterology & Nutrition*, 2021, 72(6): 820-824.
- [8] Yang F, Yan J, Liu L N, Ye B. New research progress on the etiology and pathogenesis of irritable bowel syndrome. *Journal of Hebei Medical University*, 2020, 41(8): 986-990.
- [9] Zamani M, AlizadehTabari S, Zamani V. Systematic review with meta-analysis: the prevalence of anxiety and depression in patients with irritable bowel syndrome. *Alimentary Pharmacology & Therapeutics*, 2019, 50(2): 132-143.

- [10] Hu Z, Li M, Yao L, Wang Y, Wang E, Yuan J, Wang F, Yang K, Bian Z, Zhong L L D. The level and prevalence of depression and anxiety among patients with different subtypes of irritable bowel syndrome: a network meta-analysis. *BMC Gastroenterology*, 2021, 21(1): 23.
- [11] Vazquez-Roque M I, Camilleri M, Smyrk T, Murray J A, Marietta E, O'Neill J, Carlson P, Lamsam J, Janzow D, Eckert D, Burton D, Zinsmeister A R. A controlled trial of gluten-free diet in patients with irritable bowel syndrome-diarrhea: effects on bowel frequency and intestinal function. *Gastroenterology*, 2013, 144(5): 903-911.e3.
- [12] Monsbakken K W, Vandvik P O, Farup P C. Perceived food intolerance in subjects with irritable bowel syndrome—etiology, prevalence and consequences. *European Journal of Clinical Nutrition*, 2006, 60(5): 667-672.
- [13] Ugaya N, Shiotsuki K, Nakao M. Cognitive behavioral treatment for irritable bowel syndrome: a recent literature review. *Biopsychosocial Medicine*, 2021, 15(1): 23.
- [14] Black C J, Thakur E R, Houghton L A, Quigley E M M, Moayyedi P, Ford A C. Efficacy of psychological therapies for irritable bowel syndrome: systematic review and network meta-analysis. *Gut*, 2020, 69(8): 1441-1451.
- [15] Shah K, Ramos-Garcia M, Bhavsar J, Lehrer P. Mind-body treatments of irritable bowel syndrome symptoms: an updated meta-analysis. *Behaviour Research and Therapy*, 2020, 128: 103462.
- [16] Guo Q, Jin H, Chen P, Li Y, Zhang Y, Liu Y, Wang B. Dynamic changes of intestinal flora in patients with irritable bowel syndrome combined with anxiety and depression after oral administration of enterobacteria capsules. *Bioengineered*, 2021, 12(2): 11885-11897.