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The Role of Probiotics as Adjuvant Therapy for Irritable Bowel Syndrome in Children

Ananda Rizky
RS Mawaddah Medika Mojokerto, Indonesia
Email: anandarizkygita@gmail.com

ABSTRACT
Irritable Bowel Syndrome (IBS) is a functional gastrointestinal disorder (GGIF) that is not caused by disease or organ damage. The exact pathophysiological mechanisms underlying IBS are still unknown. The pathogenesis of IBS involves alterations of gastrointestinal motility, post-infection reactivity, visceral hypersensitivity, gut-brain interactions, microbiota dysbiosis, bacterial overgrowth in the small intestine, sensitivity to food, carbohydrate malabsorption, and intestinal inflammation. Evidence of the efficacy of most pharmacological treatments for IBS is still weak, leading to unsatisfactory symptom control or the possibility of adverse reactions in many patients. The method of writing this article is in the form of a narrative review from various sources including google scholar, PubMed, and science direct with the keywords "irritable bowel syndrome" and "child" to summarize the role of probiotics as adjuvant therapy in the management of IBS in children. Probiotics are emerging as a new therapeutic option in gastrointestinal functional disorders (GGIF), along with the recognition of the importance of the gut microbiota in influencing brain-gut interactions, as well as the role of intestinal infections in the genetics of post-infectious gastrointestinal functional disorder (GGIF-PI). Therefore, probiotics have the potential to play a relevant role in the management of GGIF, both through their effects on the gut microbiota and through alterations of brain function and pain perception centrally.

Keywords: Irritable Bowel Syndrome, Child, Probiotics, Therapy, Management

Corresponding Author: Ananda Rizky
E-mail: anandarizkygita@gmail.com

INTRODUCTION

Irritable Bowel Syndrome (IBS) is a functional gastrointestinal disorder (*GGIF*) that is not caused by disease or organ damage. IBS is a common disorder and causes problems in children, with an increase in prevalence recorded over the past two decades. Studies have shown the frequency of IBS in childhood ranges from 6% to 14%, although accurate data have not been obtained (Adams et al., 2016; Al-Biltagi et al., 2022; Camilleri et al., 2016; Devanarayana & Rajindrajith, 2018; Masaoka & Kanai, 2019).

The exact pathophysiological mechanisms underlying IBS are still unknown. Several factors are thought to contribute to functional gastrointestinal disorders. Although early evidence suggested motility disorders as the primary cause, recent findings indicate that patients with functional bowel disease may have abnormal gastrointestinal reactivity to physiological stimuli (diet, intestinal distension, hormonal), nociceptive stimuli (inflammatory), and/or psychological stress (Adeniyi et al., 2017; Hollister et al., 2019; Pesce et al., 2022; Piriyakitphaiboon et al., 2022). The pathogenesis of IBS involves alterations in

gastrointestinal motility, post-infection reactivity, visceral hypersensitivity, gut-brain interactions, microbiota dysbiosis, bacterial overgrowth in the small intestine, sensitivity to food, carbohydrate malabsorption, and intestinal inflammation (Tang et al., 2021).

Recurrent Abdominal Pain (*RAP*) in childhood is an important characteristic of IBS, often accompanied by incomplete defecation and complaints of bloating and urgency to defecate (Sandhu & Paul, 2014). Overall management in children with IBS should be tailored to the patient's specific symptoms and triggers. The four main therapeutic approaches include pharmacological, dietary, psychosocial, and complementary treatment interventions (Giannetti & Staiano, 2016). Pharmacological therapies for IBS currently include antispasmodics, tricyclic antidepressants, selective serotonin reuptake inhibitors, and 5-hydroxytryptamine type-3 antagonists, which target and relieve specific symptoms. However, evidence for the efficacy of most pharmacological treatments for IBS is still weak, leading to unsatisfactory symptom control or the possibility of adverse reactions in many patients. Probiotics are emerging as a new therapeutic option in *GGIF*, given the recognition of the importance of the gut microbiota in influencing brain-gut interactions, as well as the role of intestinal infections in the genesis of post-infectious gastrointestinal functional disorder (*GGIF-PI*). Preclinical data suggest that changes in the gut microbiota may affect the brain's signaling system related to pain and associated emotional behaviors. Therefore, probiotics have the potential to play a relevant role in the management of *GGIF*, both through their effects on the gut microbiota and through alterations of brain function and central pain perception (Yang et al., 2024).

IBS is defined as a functional gastrointestinal disorder (*GGIF*) characterized by a variable combination of chronic or recurrent gastrointestinal symptoms that cannot be explained by structural or biochemical abnormalities (Devanarayana & Rajindrajith, 2018). The term "irritable bowel" describes symptoms of diarrhea, abdominal pain, and constipation in the absence of a clearly recognized infectious cause. *Recurrent Abdominal Pain* (*RAP*) in childhood is an important characteristic of IBS, accompanied by incomplete defecation and complaints of bloating and urgency to defecate (Sandhu & Paul, 2014). Studies have shown the frequency of IBS in childhood ranges from 6% to 14%, although accurate data remain scarce. In a study conducted on 454 adolescents in Indonesia in 2020, it was found that 30.8% of adolescents aged 14–18 years had IBS (Kesuma et al., 2021).

The exact pathophysiological mechanisms underlying IBS are still unknown. While preliminary evidence points to impaired motility as the primary cause, current research indicates that patients with functional bowel disease may have abnormal gastrointestinal reactivity to physiological stimuli (diet, intestinal distension, hormonal), nociceptive stimuli (inflammatory), and/or psychological stress. Impaired communication and serotonin signaling along the gut-brain axis are believed to be responsible for both gastrointestinal and psychological disturbances. Psychological events in childhood appear to be related to gastrointestinal symptoms (Pop et al., 2025). In a prospective study of 98 children who underwent upper or lower gastrointestinal endoscopy, serotonin (5-HT) signaling was found to be altered in IBS with diarrhea, but not in functional dyspepsia (Sandhu & Paul, 2014). Additionally, the pathogenesis of IBS involves alterations in gastrointestinal motility, post-infection reactivity, visceral hypersensitivity, gut-brain interactions, microbiota dysbiosis,

bacterial overgrowth in the small intestine, food sensitivities, carbohydrate malabsorption, and intestinal inflammation (Tang et al., 2021).

Currently, the diagnosis of IBS in children is based on the Rome IV criteria released in 2016. The Rome IV criteria are used to diagnose IBS, requiring the presence of pain or discomfort in the abdomen for at least 4 days per month over the last 3 months, associated with two or more of the following: improvement in abdominal pain or discomfort with defecation; onset related to changes in the frequency of bowel movements; or onset accompanied by changes in the shape or appearance of the stool. Additionally, IBS is divided into several subtypes according to dominant bowel habits: IBS-C (constipation), IBS-D (diarrhea), IBS-M (mixed bowel habits), and unclassified IBS. In the Rome IV criteria, bowel habits are assessed based on stool form only on days with abnormal bowel movements (more than 25% of total bowel movements). IBS-C is defined as more than 25% of bowel movements with Bristol stool scale type 1–2 and less than 25% with type 6–7. IBS-D is defined as more than 25% of bowel movements with type 6–7 and less than 25% with type 1–2. IBS-M is diagnosed when more than 25% of bowel movements are type 1–2 and more than 25% are type 6–7. IBS is considered unclassified if the patient meets the diagnostic criteria for IBS but their bowel habits cannot be accurately categorized into any subtype (Hyams et al., 2016; Schmulson & Drossman, 2017).

Overall management in children with IBS should be tailored to the patient's specific symptoms and triggers. The four main therapeutic approaches include dietary, psychosocial, complementary, and pharmacological interventions. Increasing dietary fiber intake is recommended as a first-line therapy for IBS, as fiber can lower intracolonic pressure, accelerate intestinal transit time, and reduce abdominal pain. Soluble fiber is especially beneficial in managing IBS-C, as it draws water into the stool and helps relieve constipation. Studies in adults have demonstrated beneficial effects of diets low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (*FODMAPs*), as well as gluten-free diets, on IBS symptoms. However, research in children remains limited. Psychosocial interventions such as cognitive behavioral therapy (CBT) and hypnotherapy (HT) have also proven effective in managing IBS. Pharmacological treatments currently include antispasmodics, tricyclic antidepressants, selective serotonin reuptake inhibitors, and 5-HT_3 antagonists, which target and relieve specific symptoms. Nonetheless, the efficacy of most pharmacological treatments for IBS remains weak, often leading to inadequate symptom control or potential adverse reactions (Yang et al., 2024; Giannetti & Staiano, 2016; Rexwinkel et al., 2022).

The prevalence and diagnosis of IBS in children have been explored in several studies. Santosa et al. (2021) reported a significant occurrence of IBS-related symptoms in children, with prevalence estimated between 6% and 14%, although a definitive diagnosis and understanding of its underlying pathophysiology remain elusive. Moreover, psychosocial factors such as stress and anxiety play a role in IBS symptomatology. Previous studies (Hikmah, 2016; Makiyah, 2015) have suggested that psychological stress often contributes to gastrointestinal discomfort in children with IBS, although the interplay between psychological stress and IBS pathophysiology, particularly in relation to gut-brain and stress signaling, has not been fully explored.

The objective of this study is to investigate the pathophysiological mechanisms of IBS in children, focusing on gut-brain signaling, psychological stress, and dietary influences. The study aims to provide a holistic understanding of how these factors contribute to IBS and to assess the potential role of probiotics and dietary strategies in its management. The implications of this research are significant for the development of targeted treatment and management plans for pediatric IBS patients, emphasizing an integrated approach that combines pharmacological, dietary, and psychological interventions.

METHOD

This study employed a systematic literature review method to evaluate the role of probiotics as adjuvant therapy in children with Irritable Bowel Syndrome (IBS). This approach was chosen to collect and critically examine the results of previously published research, including randomized clinical trials, meta-analyses, and systematic reviews. The literature reviewed was obtained from several scientific databases, including PubMed, ScienceDirect, and Google Scholar, with publication years ranging from 2013 to 2024.

The inclusion criteria for this study were articles that discussed the effects of probiotics on IBS symptoms in the pediatric population, utilized a valid study design (such as a randomized controlled trial or cohort study), and were written in English or Indonesian. Conversely, articles that did not mention dosages, probiotic strains, or that involved only adult populations were excluded during the selection process. The selection procedure was conducted in stages, starting from title screening, followed by abstract review, and finally full-text evaluation.

Data analysis was conducted by comparing the effectiveness of different types of probiotics against the primary symptoms of IBS in children, such as abdominal pain, bloating, diarrhea, or constipation. Data were classified based on probiotic strain, dose, duration of administration, and reported clinical outcomes. The results of this analysis were then synthesized narratively to illustrate the potential benefits and limitations of probiotics as an adjunct therapy in the management of IBS in the pediatric population.

RESULTS AND DISCUSSION

The Role of Gut Microbiota in Pathogenesis and Probiotics as Adjuvant Management in IBS

The pathogenesis of IBS is also related to changes in the gut microbiota, which alters gut immunity and integrity and further modulates the gut-brain axis and intestinal neuromuscular connections. The intestinal-brain axis consists of the enteric nervous system (ENS), the central nervous system (CNS), the intestinal wall in the periphery, and the hypothalamic-pituitary-adrenal (HPA) axis. Communication between the gut and the CNS is bidirectional and centers on the neurological, endocrine, and neuroimmune pathways. At the physiological level, the gastrointestinal tract sends signals that affect the brain, resulting in changes in immune function, secretion, and motility. Thus, this axis serves as the main communication center in the regulation of food intake, digestion, and sensation of adequate control of bowel movements. Structural and functional disruptions on the gut-brain axis alter

the reflexive and perceptual responses of the nervous system, potentially triggering gastrointestinal disorders, such as IBS (Tang et al., 2021).

Under normal conditions, the mucosal epithelium, where the stimulation of the homeostatic immune response occurs, maintains the integrity of the barrier and maintains tolerance to commensal bacteria by limiting microbes to the surface or lumen of the intestine. This process allows bacteria to stably colonize the intestines and perform cooperative functions. However, when these barriers are damaged by invasive inflammatory agents, pathogens, or other factors that worsen the immune response, severe inflammation occurs. This inflammatory reaction affects the gut environment because it changes the composition of the gut microbiota. A number of studies have reported on the diversity of the gut microbiome and how it relates to the severity of IBS. Evidence suggests that this dysbiosis has a pathogenic role in the development of IBS symptoms, through changes in the levels of metabolites and gases interacting with the intestinal environment (Tang et al., 2021).

Probiotics are defined as live microorganisms that, when administered in adequate amounts, provide health benefits to the host. Probiotics are used to restore impaired microbiome composition, inhibit the overgrowth of potentially pathogenic bacteria, and alter inflammation and gut permeability. Probiotics are emerging as a new therapeutic option in gastrointestinal functional disorders (GGIF), along with the recognition of the importance of the gut microbiota in influencing brain-gut interactions, as well as the role of intestinal infections in the genetics of post-infectious gastrointestinal functional disorder (GGIF-PI). A meta-analysis that included 9 clinical trials testing various probiotics as a treatment for Functional Gastrointestinal Disorder (GGIF) in children and adolescents concluded that Lactobacillus GG, Lactobacillus reuteri DSM 17938, and VSL#3 significantly improved treatment success. A randomized control trial study by Giannetti et al. (2017) showed that in children with IBS, a mixture of Bifidobacterium infantis M-63, breve M-16V, and longum BB536 was associated with improvements in abdominal pain and quality of life. In line with previous studies, a randomized control trial study by Kianifar et al. (2015) showed that Lactobacillus GG at a concentration of 1×10^10 cfu/ml over a four-week period may reduce the severity of the patient's pain and improve functional scale in patients with IBS (Giannetti & Staiano, 2016; Giannetti et al., 2017; Kianifar et al., 2015).

Preclinical data suggest that changes in the gut microbiota may affect the brain's signaling system related to pain and related emotional behaviors. Therefore, probiotics have the potential to play a relevant role in the management of GGIF, both through their effects on the gut microbiota and through alterations in brain function and pain perception centrally (Yang et al., 2024; Rexwinkel et al., 2022).

CONCLUSION

Changes in the gut microbiota can disrupt gut immunity and integrity, modulate the gut-brain axis, and trigger inflammation that exacerbates the IBS condition. Gut microbiota dysbiosis also contributes to the development of IBS symptoms through alterations in metabolites and gas production. Probiotics have emerged as a potential therapy for *GGIF* by restoring the microbiome, inhibiting pathogenic bacteria, and modulating inflammation and

intestinal permeability—both through their effects on the gut microbiota and through alterations in brain function and central pain perception.

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