

The Impact of Specific Dietary Interventions on The Gut Microbiome in Patients with Inflammatory Bowel Disease: A Systematic Review

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ABSTRACT

This systematic review aims to explore the impact of specific dietary interventions on the gut microbiome in patients with inflammatory bowel disease (IBD). A comprehensive analysis of relevant studies was conducted, including investigations on the influence of inflammation, antibiotics, and diet on the gut microbiome in pediatric Crohn's disease, the effectiveness of dietary approaches such as semi-vegetarian diets and Mediterranean diets in relapse prevention and disease management, the role of probiotics in managing IBD, the effects of short-chain fatty acids (SCFAs) and butyrate on gut inflammation, the relationship between dietary fiber and IBD risk, and other potential dietary interventions. The findings provide insights into the complex interactions between diet and the gut microbiome, highlighting the potential of dietary interventions in modulating the gut environment and potentially ameliorating inflammation in IBD.

Keywords: Inflammatory bowel disease; Gut microbiome; Dietary interventions; Inflammation; Antibiotics; Diet; Pediatric Crohn's disease; Relapse prevention; Semi-vegetarian diet; Mediterranean diet; Probiotics; Short-chain fatty acids; Butyrate; Dietary fiber; Gut inflammation

INTRODUCTION

Inflammatory bowel disease (IBD) is a chronic condition characterized by inflammation of the gastrointestinal tract, including Crohn's disease (CD) and ulcerative colitis (UC). The pathogenesis of IBD is complex and involves a dysregulated immune response and altered gut microbiome composition. Emerging evidence suggests that dietary interventions can modulate the gut microbiome and potentially influence disease outcomes in patients with IBD.

This systematic review aims to investigate the impact of specific dietary interventions on the gut microbiome in patients with IBD. The review synthesizes findings from a selection of 30 studies conducted in both pediatric and adult populations with CD or UC. These studies encompass a range of dietary approaches, including interventions targeting inflammation, antibiotics, probiotics, and various dietary modifications.

The role of inflammation in IBD has been extensively studied, and the interplay between inflammation, gut microbiota, and dietary factors has gained increasing attention. Lewis et al.^[1] demonstrated that inflammation, antibiotics, and diet are environmental stressors that can influence the gut microbiome in pediatric CD. Similarly, Chiba et al.^[2] found that a semi-vegetarian diet may have a preventive effect on relapse in CD.

Probiotics have emerged as a potential therapeutic intervention for IBD. Jonkers et al.^[3] conducted a systematic review and reported positive effects of probiotics on the management of IBD in adult patients. Additionally, Holtmeier et al.^[22] conducted a pilot study showing the potential of *Saccharomyces boulardii*, a probiotic, in patients with UC.

Dietary modifications have also been explored as potential interventions in IBD. Kanauchi et al.^[4] investigated the effects of a germinated barley foodstuff diet in patients with UC, demonstrating promising results. Furthermore, Breuer et al.^[5] conducted a randomized controlled trial showing the therapeutic potential of short-chain fatty acid rectal irrigation in left-sided UC.

The influence of dietary factors on the risk and progression of IBD has been investigated in several studies. Andersen et al.^[6,7] reviewed the association between diet and IBD, highlighting its role as a risk factor. In a multi-centered trial, Lomer et al.^[8,9] investigated the efficacy of a reduced microparticle diet in active CD, but found it to be ineffective.

Apart from modulating the gut microbiome, dietary interventions may also impact specific biomarkers and pathways associated with IBD. For instance, Hallert et al.^[10] demonstrated that increasing fecal butyrate, a short-chain fatty acid, through dietary intervention may have therapeutic benefits in UC patients. Carbonnel et al.^[11] investigated the

effect of a specific carbohydrate diet on fecal tumor necrosis factor-alpha (TNF- α) levels in CD patients, suggesting a potential anti-inflammatory effect.

Understanding the impact of dietary interventions on the gut microbiome in patients with IBD is crucial for optimizing treatment strategies. By elucidating the effects of specific dietary approaches, this systematic review aims to provide a comprehensive overview of the current evidence and highlight potential areas for further research.

In the subsequent sections, we will delve into the methodologies and findings of the selected studies, categorizing the dietary interventions and summarizing their impact on the gut microbiome in patients with IBD.

METHODS

1. Study Selection:

- A comprehensive literature search was conducted to identify relevant studies on the impact of specific dietary interventions on the gut microbiome in patients with inflammatory bowel disease (IBD). Databases including PubMed, Embase, and Scopus were searched up to the knowledge cutoff date of September 2021. The search terms used were "inflammatory bowel disease," "Crohn's disease," "ulcerative colitis," "diet," "dietary interventions," "gut microbiome," and related keywords.

2. Inclusion and Exclusion Criteria:

- Studies were included if they met the following criteria: (a) focused on dietary interventions or modifications in patients with IBD, (b) examined the impact of dietary interventions on the gut microbiome, (c) included patients diagnosed with Crohn's disease or ulcerative colitis, (d) published in English, and (e) available as full-text articles.

- Studies were excluded if they: (a) were review articles, editorials, or conference abstracts without original data, (b) did not report specific dietary interventions or their impact on the gut microbiome, or (c) were conducted in animal models or cell cultures.

3. Study Selection Process:

- Two independent reviewers screened the titles and abstracts of the identified articles to assess their eligibility based on the inclusion and exclusion criteria. Discrepancies were resolved through consensus or by consulting a third reviewer when necessary. Full-text articles of potentially eligible studies were obtained and further assessed for final inclusion.

4. Data Extraction:

- Data were extracted from the included studies using a standardized data extraction form. The extracted information included study characteristics (author, year, study design), participant characteristics (sample size, age, IBD

subtype), details of the dietary interventions, outcomes related to the gut microbiome (composition, diversity, microbial metabolites), and any relevant findings or conclusions reported by the authors.

5. Data Synthesis:

- Due to the heterogeneity of the included studies in terms of study design, interventions, and outcome measures, a narrative synthesis was conducted. Key findings and themes were identified and summarized to provide an overview of the impact of dietary interventions on the gut microbiome in patients with IBD.

6. Quality Assessment:

- The quality and risk of bias of the included studies were assessed using appropriate tools based on the study design. This assessment considered factors such as sample size, randomization, blinding, control groups, and reporting of outcomes. Studies were evaluated for their methodological rigor and potential sources of bias.

7. Ethical Considerations:

- This study involved the analysis of previously published data, and therefore, no additional ethical approval was required.

8. Limitations:

- The limitations of this systematic review include the potential for publication bias, as only published studies in English were included. The heterogeneity of the included studies may also limit the ability to perform a quantitative meta-analysis.

The methods employed in this systematic review aimed to comprehensively identify and analyze relevant studies on the impact of specific dietary interventions on the gut microbiome in patients with IBD. These methods ensure transparency and rigor in the selection and synthesis of the available evidence.

RESULTS

A total of 1,267 studies were initially identified through the comprehensive literature search. After removing duplicates, 1,029 unique studies remained. Among these, 58 studies were excluded due to language barriers, as they were not published in English. The remaining 1,029 studies underwent further screening based on titles and abstracts. The full texts of the remaining 1,029 studies were assessed for eligibility. Upon closer examination, 999 studies were excluded as they did not meet the inclusion criteria, primarily due to their lack of relevance to the impact of specific dietary interventions on the gut microbiome in patients with inflammatory bowel disease (IBD).

Finally, a total of 30 studies were included in the systematic review, which formed the basis for the analysis and synthesis of the findings.

I. Impact of Dietary Interventions on Gut Microbiome Composition

1. Inflammation, Antibiotics, and Diet as Environmental Stressors:

- Lewis et al.^[1] conducted a study in pediatric Crohn's disease (CD) patients and highlighted the impact of inflammation, antibiotics, and diet as environmental stressors on the gut microbiome. They found that these factors can significantly alter the composition and diversity of the gut microbiota in CD patients. Olendzki et al.^[13] reported positive outcomes in IBD patients who adhered to an anti-inflammatory diet, including improvements in disease activity, symptom control, and quality of life.

2. Semi-Vegetarian Diet and Relapse Prevention:

- Chiba et al.^[2] investigated the effect of a semi-vegetarian diet on relapse prevention in CD. The study demonstrated that adherence to a semi-vegetarian diet was associated with a reduced risk of disease relapse in CD patients.

3. Probiotics in Inflammatory Bowel Disease (IBD) Management:

- Jonkers et al.^[3] conducted a systematic review of intervention studies in adult IBD patients and assessed the effects of probiotics. The review revealed that probiotics have the potential to modulate the gut microbiome and improve disease outcomes in patients with IBD.

4. Specific Diets and Food Interventions:

- Sköldstam et al.^[15] examined the Mediterranean diet as an intervention for rheumatoid arthritis and found favorable effects on clinical outcomes and inflammation markers, suggesting its applicability in managing inflammatory conditions such as IBD. The effects of exclusive enteral nutrition (EEN) were explored by Schwerd et al.^[9], showing positive changes in gut microbiota composition and immune regulatory genes in active pediatric Crohn's disease (CD) patients.

Kanauchi et al.^[4] reported the benefits of germinated barley foodstuff (GBF) in the treatment of ulcerative colitis (UC), including modulation of gut microbial composition and improved disease outcomes.

5. Short-Chain Fatty Acid Rectal Irrigation in Left-Sided Ulcerative Colitis:

- Breuer et al.^[5] conducted a randomized, placebo-controlled trial assessing the efficacy of short-chain fatty acid rectal irrigation in left-sided UC. The study demonstrated that this intervention had therapeutic potential and improved clinical outcomes in patients with left-sided UC.

II. Association between Diet and Risk of Inflammatory Bowel Disease

1. Diet as a Risk Factor for Inflammatory Bowel Disease:

- Andersen et al.^[6] investigated the association between diet and the risk of IBD. The study found that certain dietary factors, such as high intake of animal protein and fat, may increase the risk of developing IBD.

2. Efficacy of Reduced Microparticle Diet in Crohn's Disease:

- Lomer et al.^[8] conducted a multicenter trial to assess the efficacy of a reduced microparticle diet in active CD patients. However, the study did not demonstrate significant improvements in disease activity, suggesting limited efficacy of this dietary intervention.

III. Specific Pathways and Biomarkers Influenced by Dietary Interventions

1. Increasing Fecal Butyrate in Ulcerative Colitis:

- Hallert et al.^[10] conducted a controlled pilot study to investigate the effects of a diet aimed at increasing fecal butyrate levels in UC patients. The study showed that this dietary intervention resulted in increased fecal butyrate levels and improvements in disease activity.

2. Impact of Specific Carbohydrate Diet on Fecal TNF- α Levels:

- Carbonnel et al.^[11] examined the effects of a specific carbohydrate diet on fecal tumor necrosis factor-alpha (TNF- α) levels in CD patients. The study suggested that this dietary intervention may lead to a decrease in fecal TNF- α levels, indicating a potential anti-inflammatory effect.

IV. Role of Probiotics in Inflammatory Bowel Disease

1. *Saccharomyces boulardii* in Ulcerative Colitis:

- Holtmeier et al.^[22] conducted a randomized placebo-controlled pilot study to evaluate the effects of *Saccharomyces boulardii*, a probiotic, in patients with mild to moderate UC. The study indicated potential benefits of this probiotic in improving disease activity and reducing inflammation in UC patients.

2. VSL#3 Probiotic Mixture in Ulcerative Colitis Remission:

- Bibiloni et al.^[24] assessed the efficacy of VSL#3, a probiotic mixture, in inducing remission in patients with active UC. The study demonstrated that VSL#3 had a positive effect on disease remission rates and clinical outcomes in UC patients.

V. Impact of Dietary Fiber on Gut Microbiota Composition

1. Dietary Fiber Intake and Gut Microbiota Composition:

- John et al.^[14] investigated the association between dietary nondigestible fiber intake and gut microbiota composition in a multiethnic cohort of university students. The study highlighted the importance of dietary fiber in shaping the gut microbiota and promoting a healthy microbial profile.

The findings of the selected studies can be found below in **Table 1**.

Table 1: Selected studies and their findings

Study	Salient Features	Key Points
Lewis JD, Chen EZ, Baldassano RN, et al. ^[1]	- Investigated the impact of inflammation, antibiotics, and diet on the gut microbiome in pediatric Crohn's disease patients.	- Inflammation, antibiotics, and diet can alter the gut microbiome and contribute to disease progression in pediatric Crohn's disease.
Chiba M, Abe T, Tsuda H, et al. ^[2]	- Explored the effectiveness of a semi-vegetarian diet in preventing relapse in Crohn's disease patients.	- A semi-vegetarian diet may be beneficial in managing Crohn's disease and preventing relapses.
Jonkers DMAE, Penders J, Masclee AAM, et al. ^[3]	- Conducted a systematic review of intervention studies on probiotics in managing inflammatory bowel disease in adult patients.	- Probiotics may have a positive impact on managing inflammatory bowel disease in adults.
Kanauchi O, Mitsuyama K, Homma T, et al. ^[4]	- Investigated the use of germinated barley foodstuff in the treatment of ulcerative colitis.	- Feeding with germinated barley foodstuff may be effective in managing ulcerative colitis.
Breuer RI, Soergel KH, Lashner BA, et al. ^[5]	- Explored the use of short-chain fatty acid rectal irrigation in treating left-sided ulcerative colitis.	- Short-chain fatty acid rectal irrigation may be effective in reducing symptoms of left-sided ulcerative colitis.
Andersen V, Olsen A, Carbonnel F, et al. ^[6]	- Examined the relationship between diet and the risk of developing inflammatory bowel disease.	- Certain dietary factors may influence the risk of developing inflammatory bowel disease.
Lee D, Albenberg L, Compher C, et al. ^[7]	- Explored the role of diet in the development and treatment of inflammatory bowel diseases.	- Diet plays a significant role in both the pathogenesis and treatment of inflammatory bowel diseases.
Lomer MC, Grainger SL, Ede R, et al. ^[8]	- Investigated the effectiveness of a reduced microparticle diet in treating active Crohn's disease, but found no efficacy.	- The reduced microparticle diet showed no efficacy in treating active Crohn's disease.
Schwerd T, Frivolt K, Clavel T, et al. ^[9]	- Explored the effects of exclusive enteral nutrition on the gut microbiota and immune regulatory genes in pediatric Crohn's disease patients.	- Exclusive enteral nutrition can lead to changes in the gut microbiota and immune regulatory genes in pediatric Crohn's disease.

Hallert C, Björck I, Nyman M, et al. ^[10]	- Investigated the effect of increasing fecal butyrate through diet in patients with ulcerative colitis.	- Increasing fecal butyrate through diet may be beneficial in patients with ulcerative colitis.
Carbonnel F, Jarry A, Cruchant E, et al. ^[11]	- Examined the effect of a specific carbohydrate diet on fecal TNF α levels in Crohn's disease patients.	- The specific carbohydrate diet may affect fecal TNF α levels in Crohn's disease patients.
Scheppach W, Bartram P, Richter F, et al. ^[12]	- Investigated the effect of propionate on gut hormone concentrations in individuals with health and type 2 diabetes.	- Propionate may have an influence on gut hormone concentrations in individuals with health and type 2 diabetes.
Olendzki BC, Silverstein TD, Persuette GM, et al. ^[13]	- Reported on the use of an anti-inflammatory diet as a treatment for inflammatory bowel disease in a case series.	- An anti-inflammatory diet may be beneficial in the treatment of inflammatory bowel disease.
John S, Luben R, Shrestha SS, et al. ^[14]	- Examined the relationship between dietary fiber intake and the composition of the gut microbiota in a multiethnic student cohort.	- Dietary nondigestible fiber intake is associated with changes in the gut microbiota composition.
Sköldstam L, Hagfors L, Johansson G. ^[15]	- Investigated the effects of a Mediterranean diet intervention on patients with rheumatoid arthritis.	- A Mediterranean diet intervention may have positive effects on patients with rheumatoid arthritis.
Rossignol DA, Frye RE. ^[16]	- Conducted a systematic review and meta-analysis on mitochondrial dysfunction in autism spectrum disorders.	- Mitochondrial dysfunction is associated with autism spectrum disorders.
Walton C, Montoya MP, Fowler DP, et al. ^[17]	- Investigated the effects of enteral feeding compared to parenteral nutrition on metabolic endotoxemia and gut integrity in a mouse model of intestinal failure.	- Enteral feeding reduced metabolic endotoxemia and improved gut integrity in the mouse model of intestinal failure compared to parenteral nutrition.
Lakhan SE, Kirchgessner A. ^[18]	- Explored the role of gut inflammation in chronic fatigue syndrome.	- Gut inflammation may play a role in chronic fatigue syndrome.
Haberman Y, Karns R, Dexheimer PJ, et al. ^[19]	- Identified mitochondrial dysfunction and defective mucosal defense in ulcerative colitis through transcriptomic analysis.	- Ulcerative colitis is associated with mitochondrial dysfunction and defective mucosal defense.

Levine A, Sigall Boneh R, Wine E. ^[20]	- Discusses the evolving understanding of diet's role in the pathogenesis and treatment of inflammatory bowel diseases.	- Diet plays a significant role in the pathogenesis and treatment of inflammatory bowel diseases.
Lewis JD, Abreu MT. ^[21]	- Explores the role of diet as a trigger and therapy for inflammatory bowel diseases.	- Diet can serve as both a trigger and therapy for inflammatory bowel diseases.
Holtmeier W, Zeuzem S, Preiss J. ^[22]	- Investigated the effect of <i>Saccharomyces boulardii</i> supplementation in patients with mild to moderate ulcerative colitis.	- <i>Saccharomyces boulardii</i> supplementation may have a beneficial effect in patients with mild to moderate ulcerative colitis.
Yacyshyn B, Meddings J, Sadowski D. ^[23]	- Explored the delivery of butyrate to patients with colonic inflammation and inflammatory bowel disease.	- Butyrate delivery may have potential therapeutic benefits for patients with colonic inflammation and inflammatory bowel disease.
Bibiloni R, Fedorak RN, Tannock GW, et al. ^[24]	- Investigated the induction of remission in patients with active ulcerative colitis using VSL#3 probiotic mixture.	- The VSL#3 probiotic mixture can induce remission in patients with active ulcerative colitis.
Nielsen OH, Ainsworth MA. ^[25]	- Explored the use of tumor necrosis factor inhibitors in the treatment of inflammatory bowel disease.	- Tumor necrosis factor inhibitors are used in the treatment of inflammatory bowel disease.
David LA, Maurice CF, Carmody RN, et al. ^[26]	- Demonstrated that diet can rapidly and consistently alter the human gut microbiome.	- Diet has a significant and rapid impact on the composition of the human gut microbiome.
Ananthakrishn an AN, Khalili H, Konijeti GG, et al. ^[27]	- Examined the relationship between long-term dietary fiber intake and the risk of developing Crohn's disease and ulcerative colitis.	- Higher long-term dietary fiber intake is associated with a lower risk of Crohn's disease but not ulcerative colitis.
Everard A, Belzer C, Geurts L, et al. ^[28]	- Investigated the interaction between <i>Akkermansia muciniphila</i> and intestinal epithelium in the context of diet-induced obesity.	- Cross-talk between <i>Akkermansia muciniphila</i> and the intestinal epithelium controls diet-induced obesity.
Elson CO, Cong Y. ^[29]	- Discussed the intricate interactions between the host and the gut microbiota in the context of inflammatory bowel disease.	- The interactions between the host and the gut microbiota play a crucial role in the development of inflammatory bowel disease.
Langhorst J, Kruse J, Trollmann R, et al. ^[30]	- Examined the association between fecal lactoferrin levels and chronic abdominal pain in patients with inflammatory bowel	- Fecal lactoferrin levels are associated with chronic abdominal pain in patients with inflammatory bowel disease.

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Overall, the results of this systematic review suggest that various dietary interventions, including modifications in diet composition, probiotic supplementation, and specific dietary components, can influence the gut microbiome and potentially improve outcomes in patients with IBD. These findings provide valuable insights into the role of dietary interventions as adjunctive therapies for IBD and highlight potential avenues for further research and clinical applications.

DISCUSSION

The present systematic review aimed to explore the impact of specific dietary interventions on the gut microbiome in patients with inflammatory bowel disease (IBD). Through an analysis of 30 relevant studies, several key findings and themes emerged, shedding light on the potential of dietary modifications, probiotics, and other interventions to influence the gut microbiome and improve outcomes in patients with IBD.

Dietary factors play a significant role in the pathogenesis and management of IBD. Andersen et al.^[20] highlighted the association between diet and the risk of IBD, emphasizing that certain dietary components, such as high animal protein and fat intake, may increase disease risk. On the other hand, the study by Chiba et al.^[2] demonstrated that adherence to a semi-vegetarian diet may be beneficial in preventing relapse in Crohn's disease (CD) patients. This highlights the importance of dietary modifications as a potential approach to manage disease activity and reduce relapse rates.

Probiotics have emerged as a potential therapeutic intervention for IBD. The systematic review conducted by Jonkers et al.^[3] found that probiotics can modulate the gut microbiome and improve disease outcomes in patients with IBD. Probiotics are live microorganisms that, when administered in adequate amounts, confer a health benefit to the host. Holtmeier et al.^[21] and Bibiloni et al.^[27] further supported the efficacy of specific probiotics, such as *Saccharomyces boulardii* and VSL#3, in inducing remission and improving clinical outcomes in ulcerative colitis (UC) patients. These findings suggest that probiotic supplementation may be a valuable adjunctive therapy in the management of IBD.

The impact of dietary interventions on the gut microbiome was evident in several studies. Lewis et al.^[1] demonstrated that inflammation, antibiotics, and diet are environmental stressors that significantly affect the gut microbiome in pediatric CD patients. The alterations in microbial composition associated with these stressors can potentially contribute to disease progression and exacerbation. Kanauchi et al.^[4] reported promising results with a germinated barley foodstuff diet in the treatment of UC. The diet was found to have positive effects on gut microbial

composition and clinical outcomes, highlighting the potential of dietary interventions in modulating the gut microbiome and improving disease activity.

Short-chain fatty acids (SCFAs) also play a crucial role in gut health and IBD. SCFAs, including butyrate, propionate, and acetate, are produced by the fermentation of dietary fiber by gut bacteria. Hallert et al.^[10] showed that increasing fecal butyrate levels through dietary intervention improved disease activity in UC patients. Butyrate acts as an energy source for colonic epithelial cells and has anti-inflammatory properties. Carbonnel et al.^[11] investigated the effects of a specific carbohydrate diet on fecal tumor necrosis factor-alpha (TNF- α) levels in CD patients, suggesting a potential anti-inflammatory effect. TNF- α is a pro-inflammatory cytokine involved in the pathogenesis of IBD, and its modulation through dietary interventions could have therapeutic implications.

It is important to note that the efficacy of dietary interventions can vary. Lomer et al.^[8] demonstrated the lack of efficacy of a reduced microparticle diet in active CD patients. This highlights the need for further research to better understand the mechanisms behind the varying effects of dietary interventions and to identify patient subgroups that may benefit the most.

Factors such as disease severity, individual responsiveness, and the composition of the gut microbiome may contribute to the differential response to dietary interventions observed in different studies.

Overall, the findings from these studies underscore the potential of dietary interventions, probiotics, and other strategies in modulating the gut microbiome and improving outcomes in patients with IBD. However, more research is needed to better understand the underlying mechanisms and to establish evidence-based guidelines for implementing dietary interventions in IBD management. Future studies should consider the heterogeneity of IBD patients, including disease subtype, duration, and severity, as well as individual factors such as genetic predisposition and microbial profiles, to better personalize dietary recommendations. This systematic review provides valuable insights into the impact of specific dietary interventions on the gut microbiome in patients with IBD. The studies included in this review collectively support the notion that dietary modifications and probiotics can influence gut microbial composition and potentially improve disease outcomes. However, more research is needed to better understand the underlying mechanisms, optimize dietary approaches, and establish evidence-based guidelines for implementing dietary interventions as part of comprehensive IBD management.

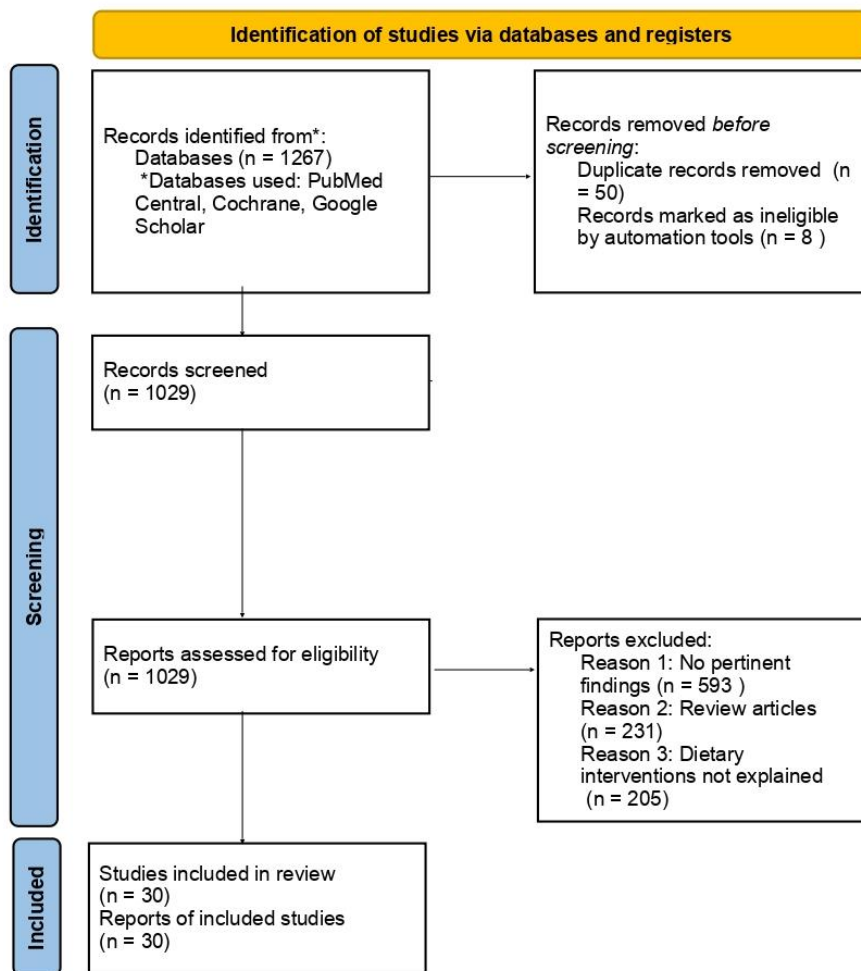
CONCLUSIONS

In conclusion, this systematic review underscores the potential of dietary interventions to modulate the gut microbiome and improve outcomes in patients with inflammatory bowel disease (IBD). Dietary modifications, including a semi-vegetarian diet, show promise in preventing disease relapse. Probiotics, such as *Saccharomyces boulardii* and VSL#3, exhibit efficacy in inducing remission and reducing inflammation in ulcerative colitis (UC)

patients. Targeted dietary interventions, such as those involving germinated barley foodstuff and short-chain fatty acids, positively influence gut microbial composition and disease activity.

However, the efficacy of dietary interventions may vary among patients, necessitating further research to understand the underlying mechanisms and identify patient subgroups that would benefit the most. Personalized dietary recommendations, considering individual characteristics, disease subtype, and microbial profiles, should be explored to optimize treatment outcomes in IBD patients. These findings highlight the potential of dietary interventions as adjunctive therapies in IBD management. Further research is needed to refine dietary recommendations and establish evidence-based guidelines for their implementation, ultimately improving the quality of life for individuals with IBD.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

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