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## **Diets in Inflammatory Bowel Diseases**

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## **ABSTRACT**

**Introduction:** Inflammatory bowel diseases (IBD) comprise Crohn's disease (CD) and ulcerative colitis (UC). Current therapies are based on classical pharmacotherapy, biological treatment, and surgical interventions. In the pediatric population with IBD, diet plays an important role in achieving clinical remission. In recent years, the role of environmental components — including diet and the gut microbiome — has become an increasingly investigated topic.

**Aim:** The aim of this paper is to review the literature on dietary interventions in inflammatory bowel diseases (IBD), focusing on their efficacy in inducing remission, reducing inflammatory markers, and improving patient symptoms.

**Material and Methods:** A systematic review was conducted using the PubMed database, covering 10 years of research on diet in inflammatory bowel diseases. Only articles written in English and involving human subjects were included.

**Results:** The analysis of 19 studies confirms that the Crohn's Disease Exclusion Diet (CDED) combined with Partial Enteral Nutrition (PEN) is equivalently efficacious to Exclusive Enteral Nutrition (EEN) in inducing remission in pediatric CD, with significantly higher patient adherence. Head-to-head comparisons showed no clinical or biochemical superiority of the Specific Carbohydrate Diet (SCD) over the Mediterranean Diet (MD). The Low-FODMAP Diet (LFD) effectively reduced functional symptoms but failed to lower inflammatory markers such as fecal calprotectin.

**Conclusions:** Diet is a potent tool in inducing and maintaining IBD remission. Nutritional therapy has evolved from supportive care to a primary treatment modality. CDED combined with PEN is the preferred option for inducing remission in the pediatric population with CD. In maintenance therapy, diets such as the Mediterranean Diet should be prioritized over restrictive elimination diets (SCD). The LFD should be used only for symptomatic relief. Future research comparing head-to-head nutritional interventions is needed to draw further conclusions.

**Keywords:** Crohn's disease; ulcerative colitis; diet; inflammatory bowel disease

## 1. INTRODUCTION

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Inflammatory bowel disease (IBD) is a chronic disorder comprising Crohn's disease (CD) and ulcerative colitis (UC). In CD, any part of the gastrointestinal tract can be affected, whereas in UC, inflammation is limited to the large intestine [2]. The pathogenesis of IBD is increasingly viewed as a maladaptive immune response to environmental triggers and microbial factors [3]. It is considered that diet and the microbiome are among the main factors that initiate and perpetuate the process of intestinal inflammation [1].

The marked increase in the global incidence of IBD over recent decades has highlighted the important role of non-genetic susceptibility and environmental components in disease pathogenesis [1]. Progress in the field of microbiome research has demonstrated that the gut microbiome appears to play an important role in the pathogenesis of IBD, and that diet may in

turn impact the composition and functionality of the microbiome [1]. Uncontrolled clinical studies have demonstrated that various dietary therapies — such as exclusive enteral nutrition and newly developed exclusion diets — may be potent tools for the induction of remission at disease onset, for patients failing biological therapy, as a treatment for disease complications, and in reducing the need for surgery [1].

IBD is also associated with a range of extraintestinal manifestations (EIMs) affecting the musculoskeletal, cutaneous, ocular, and hepatobiliary systems, arising in 5–50% of all IBD patients [2]. These manifestations may result in significant morbidity, often exceeding that caused by the intestinal disease itself, and must be considered in the overall management strategy [2].

The pathogenesis of IBD involves a complex interaction between genetic, environmental, and microbial factors and the host immune response [3]. Dysregulation of the intestinal immune system — particularly involving innate and adaptive immunity — plays a central role in sustaining chronic mucosal inflammation [3]. Understanding these mechanisms has provided the rationale for dietary interventions targeting microbial composition and intestinal barrier integrity as complementary or primary therapeutic strategies.

The aim of this paper is to review the literature on dietary interventions in IBD, focusing on their efficacy in inducing remission, reducing inflammatory markers, and improving patient symptoms.

## **2. MATERIAL AND METHODS**

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A systematic review was conducted using the PubMed database, covering 10 years of research on diet in inflammatory bowel diseases. The search strategy employed the following terms and their combinations: *inflammatory bowel disease, Crohn's disease, ulcerative colitis, diet, nutrition, enteral nutrition, exclusive enteral nutrition, Crohn's Disease Exclusion Diet, Mediterranean diet, Specific Carbohydrate Diet, Low-FODMAP diet, remission, gut microbiota, and intestinal permeability.*

Only articles written in English and involving human subjects were included. Studies were eligible if they reported on dietary or nutritional interventions in patients with CD or UC, with outcomes including clinical remission, endoscopic remission, biochemical inflammatory

markers (such as C-reactive protein and fecal calprotectin), or patient-reported symptom scores. A total of 19 studies were selected and included in the final analysis.

The following were excluded from the review: animal studies, case reports, conference abstracts, letters without original data, and studies not reporting clinical or biochemical outcomes related to dietary interventions in IBD.

### **3. RESULTS**

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#### **3.1. Exclusive Enteral Nutrition**

Exclusive enteral nutrition (EEN) is a well-established dietary therapy for the induction of remission in pediatric Crohn's disease. EEN involves the complete replacement of normal dietary intake with a liquid formula for a defined period, typically 6–8 weeks. Multiple studies and meta-analyses have demonstrated that EEN achieves remission rates comparable to corticosteroids in pediatric CD, while additionally promoting mucosal healing and improving nutritional status [4,5].

The mechanisms underlying the efficacy of EEN are not fully elucidated but are thought to involve modulation of the gut microbiome, reduction of dietary antigens that may trigger immune activation, improvement of intestinal barrier function, and provision of adequate macro- and micronutrients to support mucosal repair [4,5,6]. EEN has also been shown to reduce markers of systemic inflammation, including C-reactive protein and erythrocyte sedimentation rate, and to normalize fecal calprotectin levels in a proportion of treated patients [5].

Despite its efficacy, EEN is associated with significant challenges regarding patient adherence, particularly in adolescents and adults, due to the palatability of liquid formulas and the social and psychological burden of complete dietary exclusion [4,6]. These limitations have motivated the development of partial enteral nutrition strategies combined with exclusion diets that allow some normal food intake while maintaining therapeutic efficacy.

#### **3.2. Crohn's Disease Exclusion Diet Combined with Partial Enteral Nutrition**

The Crohn's Disease Exclusion Diet (CDED) is a structured dietary intervention designed to reduce exposure to dietary components that may adversely affect the gut microbiome and

intestinal barrier function. CDED is typically combined with partial enteral nutrition (PEN), in which a liquid formula provides 50% of caloric requirements in the first phase and 25% in the second phase, with the remainder of calories derived from allowed whole foods [7,8].

The dietary components restricted in CDED include animal fat, processed foods, emulsifiers, carrageenan, maltodextrin, and sulfites, which have been hypothesized to promote dysbiosis, increase intestinal permeability, and activate pro-inflammatory pathways [7]. Conversely, foods associated with a favorable microbiome profile — including fruits, vegetables, legumes, and lean proteins — are encouraged [7,8].

The pivotal PRODUCE trial compared CDED+PEN with EEN in pediatric patients with mild-to-moderate CD [7]. At week 6, both groups achieved comparable rates of clinical remission (approximately 75%), with no statistically significant difference between the two interventions. However, CDED+PEN demonstrated significantly superior patient adherence, with a lower dropout rate and higher rates of sustained remission at week 12 [7]. These findings were corroborated by subsequent studies demonstrating that CDED+PEN effectively reduces fecal calprotectin, CRP, and other inflammatory markers, while also inducing favorable shifts in gut microbiome composition [8].

CDED+PEN has therefore emerged as a preferred first-line dietary intervention for induction of remission in pediatric CD, offering equivalent efficacy to EEN with substantially improved tolerability and adherence [7,8].

### **3.3. Specific Carbohydrate Diet**

The Specific Carbohydrate Diet (SCD) is a dietary intervention originally developed for the management of intestinal disorders, based on the hypothesis that complex carbohydrates — particularly disaccharides and polysaccharides — promote the overgrowth of harmful intestinal bacteria and perpetuate mucosal inflammation [9,10]. The SCD restricts all grains, most dairy products, refined sugars, and certain legumes, while permitting monosaccharides, certain fruits and vegetables, and specific proteins [9].

Several observational and prospective studies have reported improvements in clinical symptoms, quality of life, and inflammatory markers in IBD patients following the SCD [9,10,11]. However, the largest and most methodologically rigorous head-to-head comparison to date — the DINE-CD trial — compared the SCD with the Mediterranean Diet (MD) in adult

patients with mild-to-moderate CD [12]. This randomized controlled trial found no statistically significant difference between the two diets in rates of symptomatic remission or reduction in fecal calprotectin at 12 weeks [12]. Both diets were associated with improvements in patient-reported outcomes, but neither demonstrated clear biochemical superiority over the other [12]. These findings suggest that the SCD does not offer additional clinical or biochemical benefit over a less restrictive dietary pattern such as the MD in adult CD patients. Given the greater dietary restrictions and potential nutritional risks associated with the SCD, the MD may represent a more sustainable and nutritionally balanced alternative for long-term dietary management in IBD [12,13].

### **3.4. Mediterranean Diet**

The Mediterranean Diet (MD) is characterized by high consumption of fruits, vegetables, whole grains, legumes, nuts, olive oil, and fish, with moderate consumption of poultry and dairy products, and low consumption of red and processed meats and refined sugars [13,14]. This dietary pattern is associated with anti-inflammatory properties, favorable modulation of the gut microbiome, and reduced systemic oxidative stress, making it a theoretically attractive dietary intervention for IBD [13,14].

Observational studies have demonstrated that adherence to the MD is inversely associated with IBD incidence and disease activity [13]. Prospective intervention studies have reported improvements in quality of life, reduction in disease activity scores, and favorable changes in gut microbiome composition in IBD patients following the MD [14]. As noted above, the DINE-CD trial demonstrated that the MD achieved comparable remission rates to the SCD in adult CD patients, with the additional advantages of greater dietary variety, improved nutritional adequacy, and higher patient acceptability [12].

The MD is also associated with increased production of short-chain fatty acids (SCFAs) — particularly butyrate — through fermentation of dietary fiber by colonic bacteria [13,14]. SCFAs play important roles in maintaining intestinal barrier integrity, modulating mucosal immune responses, and providing energy to colonocytes, mechanisms that are directly relevant to IBD pathophysiology [14]. On the basis of current evidence, the MD represents a preferred dietary pattern for the long-term management and maintenance of remission in IBD patients [13,14].

### **3.5. Low-FODMAP Diet**

The Low-FODMAP Diet (LFD) restricts fermentable oligosaccharides, disaccharides, monosaccharides, and polyols — short-chain carbohydrates that are poorly absorbed in the small intestine and rapidly fermented by colonic bacteria, leading to gas production, osmotic effects, and luminal distension [15,16]. The LFD was originally developed for the management of irritable bowel syndrome (IBS) and has been subsequently investigated in IBD patients, particularly those with coexisting functional gastrointestinal symptoms [15].

Multiple studies have demonstrated that the LFD effectively reduces functional symptoms in IBD patients, including bloating, abdominal pain, flatulence, and altered bowel habits [15,16,17]. These symptomatic improvements can be clinically significant, as functional symptoms are common in IBD patients even during periods of mucosal remission and can substantially impair quality of life [15].

However, the LFD has consistently failed to demonstrate a significant reduction in objective inflammatory markers, including fecal calprotectin, CRP, and endoscopic indices of mucosal inflammation [16,17]. This finding indicates that the LFD does not modify the underlying inflammatory process in IBD and should not be used as a primary therapy for induction or maintenance of remission. Furthermore, long-term adherence to the LFD carries potential risks, including reduction in dietary fiber intake, adverse effects on gut microbiome diversity, and nutritional inadequacy [16].

The LFD is therefore recommended as a short-term adjunctive intervention for symptomatic relief in IBD patients with coexisting functional symptoms, rather than as a primary anti-inflammatory dietary strategy [15,16,17].

### **3.6. Other Dietary Interventions**

Several additional dietary strategies have been investigated in IBD, including the anti-inflammatory diet (AID), the IBD-Anti-Inflammatory Diet (IBD-AID), the Paleolithic diet, and various elimination diets [18,19]. These interventions share common features with the SCD and MD, including restriction of processed foods, refined sugars, and pro-inflammatory dietary components, while emphasizing whole foods, dietary fiber, and omega-3 fatty acids [18].

Observational and pilot studies have reported improvements in disease activity and inflammatory markers with these dietary patterns; however, the evidence base remains limited

by small sample sizes, heterogeneous study designs, and the absence of randomized controlled trials with adequate follow-up [18,19]. The IBD-AID, which incorporates prebiotic and probiotic components in addition to dietary restriction, has shown particular promise in preliminary studies, with reported reductions in disease activity scores and inflammatory markers in both CD and UC patients [18].

**Table 1. Summary of major dietary interventions in inflammatory bowel diseases, including target population, primary mechanism, key evidence, and clinical recommendation.**

| Dietary Intervention                            | Target Population        | Primary Mechanism   | Key Evidence  | Clinical Recommendation   |
|---|--------------------------|---|---|---|
| Exclusive Enteral Nutrition (EEN)               | Pediatric CD (induction) | Microbiome modulation; antigen exclusion; mucosal healing                 | Comparable to corticosteroids for remission induction; promotes mucosal healing | First-line for pediatric CD induction; limited by adherence     |
| Crohn's Disease Exclusion Diet + PEN (CDED+PEN) | Pediatric CD (induction) | Restriction of pro-inflammatory dietary components; microbiome modulation | Equivalent to EEN in remission induction; superior adherence (PRODUCE trial)    | Preferred first-line dietary therapy for pediatric CD induction |

| Dietary Intervention                 | Target Population             | Primary Mechanism   | Key Evidence  | Clinical Recommendation                                       |
|--------------------------------------|-------------------------------|---|---|---|
| Mediterranean Diet (MD)              | Adult CD and UC (maintenance) | Anti-inflammatory; SCFA production; microbiome diversity              | Comparable to SCD in DINE-CD trial; superior nutritional adequacy       | Preferred dietary pattern for IBD maintenance therapy         |
| Specific Carbohydrate Diet (SCD)     | Adult CD and UC               | Restriction of complex carbohydrates; microbiome modulation           | No superiority over MD in DINE-CD trial                                 | Not preferred over MD; may be considered in selected patients |
| Low-FODMAP Diet (LFD)                | IBD with functional symptoms  | Reduction of fermentable substrates; symptomatic relief               | Effective for functional symptoms; no reduction in inflammatory markers | Short-term adjunctive therapy for symptomatic relief only     |
| IBD-Anti-Inflammatory Diet (IBD-AID) | Adult CD and UC               | Prebiotic/probiotic components; restriction of pro-inflammatory foods | Preliminary evidence of reduced disease activity; limited RCT data      | Investigational; further RCT evidence required                |

Source: authors' own compilation based on reviewed literature [4–19].

#### 4. DISCUSSION

The results of this review confirm that dietary interventions have evolved from a supportive role in IBD management to a primary treatment modality, particularly in the pediatric population with CD. The evidence base for nutritional therapy in IBD has expanded substantially over the past decade, driven by advances in understanding of the gut microbiome,

intestinal barrier function, and the immunological mechanisms underlying chronic intestinal inflammation [1,3].

The most robust evidence supports CDED+PEN as the preferred dietary intervention for induction of remission in pediatric CD. The PRODUCE trial demonstrated that CDED+PEN achieves remission rates equivalent to EEN while offering significantly superior patient adherence — a critical advantage in a population in which treatment compliance is a major determinant of clinical outcomes [7]. The mechanistic basis for the efficacy of CDED+PEN appears to involve restriction of dietary components that promote dysbiosis and intestinal barrier disruption, combined with the nutritional support provided by partial enteral nutrition [7,8].

The DINE-CD trial represents a landmark contribution to the evidence base for dietary management of adult CD. The finding that the SCD and MD achieved comparable remission rates challenges the assumption that more restrictive dietary interventions are necessarily more efficacious [12]. Given the greater dietary variety, nutritional adequacy, and long-term sustainability of the MD, these findings support the prioritization of the MD over the SCD in clinical practice for adult IBD patients [12,13]. The MD's established anti-inflammatory properties, favorable effects on gut microbiome diversity, and association with increased SCFA production provide additional mechanistic support for its role in IBD management [13,14].

The LFD occupies a distinct position in the IBD dietary landscape. Its consistent efficacy in reducing functional gastrointestinal symptoms — which are prevalent in IBD patients even during mucosal remission — makes it a clinically valuable adjunctive intervention [15,16]. However, the absence of any demonstrated effect on objective inflammatory markers clearly delineates its role as a symptomatic rather than anti-inflammatory therapy [16,17]. Clinicians should be cautious about the long-term use of the LFD given its potential adverse effects on gut microbiome diversity and nutritional status [16].

Several limitations of the current evidence base should be acknowledged. The majority of dietary intervention studies in IBD are limited by small sample sizes, heterogeneous patient populations, short follow-up periods, and the inherent difficulty of blinding dietary interventions in randomized controlled trials. Variability in outcome measures — particularly the use of patient-reported symptom scores versus objective endoscopic and biochemical endpoints — complicates cross-study comparisons. Furthermore, the interaction between

dietary interventions and concomitant pharmacological therapy (including biologics and immunomodulators) remains insufficiently characterized in the existing literature.

Future research should prioritize large, well-designed randomized controlled trials with standardized outcome measures, adequate follow-up periods, and stratification by disease phenotype, location, and severity. Head-to-head comparisons of dietary interventions with active pharmacological comparators would be particularly valuable in establishing the relative contribution of dietary therapy to overall IBD management. Additionally, the integration of microbiome profiling and metabolomic analyses into dietary intervention studies may help identify patient subgroups most likely to benefit from specific dietary strategies.

## 5. CONCLUSIONS

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Diet is a potent tool in inducing and maintaining remission in inflammatory bowel diseases. Nutritional therapy has evolved from a supportive role to a primary treatment modality, particularly in the pediatric population with Crohn's disease.

CDED combined with PEN is the preferred option for inducing remission in pediatric CD, offering equivalent efficacy to EEN with significantly superior patient adherence. In maintenance therapy, the Mediterranean Diet should be prioritized over restrictive elimination diets such as the SCD, as current evidence does not support the clinical or biochemical superiority of the SCD. The Low-FODMAP Diet should be reserved for short-term symptomatic relief in patients with coexisting functional gastrointestinal symptoms and should not be used as a primary anti-inflammatory intervention.

Future research comparing head-to-head nutritional interventions with standardized endpoints and adequate follow-up is needed to further define the role of dietary therapy in IBD management and to identify patient subgroups most likely to benefit from specific dietary strategies.

## DISCLOSURES

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### Authors' Contributions

|                           |            |
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|---------------------------|------------|

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