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Review

The Place of Nutrition in Adult Inflammatory Bowel Disease

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Abstract

Malnutrition is observed in 20–85% of patients with inflammatory bowel disease (IBD), while obesity affects 15–40%, sarcopenia is present in 17%, and frailty in 18%. Nutritional therapy plays a dual role in IBD management: both as a supportive intervention to correct nutritional deficiencies and as a primary treatment to modulate intestinal inflammation. Both exclusive enteral nutrition (EEN) and partial enteral nutrition (PEN) are commonly utilized therapeutic approaches to induce remission, especially in pediatric patients. Malnutrition and sarcopenia should be screened for, evaluated if necessary, and treated appropriately in patients with IBD. If left untreated, prognosis, complications, and quality of life will be negatively affected. For IBD patients in remission, the Mediterranean diet is recommended. This diet encourages the consumption of fresh fruits and vegetables, lean proteins, complex carbohydrates, and monounsaturated fats. In addition, patients should avoid ultra-processed foods, added sugars, and excess salt. A specific "IBD diet" to induce remission in patients with active IBD has not yet been defined. Currently, several dietary approaches, such as the Mediterranean diet, specific carbohydrate diet, and Crohn's Disease Exclusion Diet (CDED), are recommended for symptom resolution in some patients. Dietary management should be tailored to each patient's condition and nutritional needs. Enteral nutrition (EN) is the preferred nutritional method when oral intake is inadequate. The aphorism "If you don't feed the patient, feed the intestines" should not be forgotten. Parenteral nutrition (PN) is recommended in cases of intra-abdominal abscess, phlegmonous inflammation, intestinal failure, bowel obstruction, anastomotic leak, gastrointestinal fistula, ileus, short bowel syndrome, or when EN has been tried and found to be unsuccessful, and when enteral access is not available. EEN is a form of nutrition in which only an enteral formula is used as the sole food source for 6–8 weeks. EEN is specifically used to induce remission in pediatric patients with Crohn's disease (CD) instead of corticosteroid (CS) therapy. However, its role is also increasing in adult Crohn's patients. The nutritional approach should be implemented by a multidisciplinary team including a physician, nurse, and dietitian.
Keywords: Enteral nutrition, exclusive enteral nutrition, inflammatory bowel disease, malnutrition, oral nutritional supplements, parenteral nutritio

INTRODUCTION

In this chapter, nutrition-related conditions and nutritional management in clinical practice in IBD will be discussed in detail.

NUTRITION-RELATED CONDITIONS

Malnutrition:

Malnutrition is a condition in which energy or nutrient intake is insufficient, excessive, or unbalanced relative to the individual's needs. Malnutrition leads to increased morbidity and mortality, a worsening of the clinical course, and higher healthcare costs.[1]

Malnutrition criteria were published by the European Society of Parenteral and Enteral Nutrition (ESPEN) in 2015,[2] and by the Global Leadership Initiative on Malnutrition (GLIM) in 2019.[3] According to ESPEN, the criteria for malnutrition include:

1. Decrease in body mass index (BMI)
2. Weight loss
3. Muscle mass loss

GLIM criteria take into account phenotypic factors such as weight loss, low BMI, and low muscle mass, as well as etiologic factors such as reduced food intake and disease burden.[4]

According to the World Health Organization (WHO), malnutrition includes two categories:[5]

1. Overweight, obesity, and diet-related non-communicable diseases such as diabetes mellitus (DM), stroke, heart disease, and some cancers
2. Undernutrition, which includes wasting (low weight-for-height), underweight (low weight-for-age), stunting (low height-for-age), and micronutrient deficiencies

Diagnostic criteria and numerical threshold values for the diagnosis of malnutrition have not been described in this definition.

Clinical malnutrition definitions are currently used according to the criteria of ESPEN, GLIM and WHO.

Overweight and Obesity

Obesity is defined as excessive fat accumulation that leads to chronic diseases such as type 2 DM, dyslipidemia, hypertension (HT), cardiovascular diseases (CVD), and other inflammation-related conditions, in addition to being a chronic illness itself.[6] Overweight and obesity classifications are defined according to BMI (Table 1).

In addition to an increase in body weight, fat accumulation in the abdomen and trunk is defined as central obesity. In this condition, the risks of metabolic syndrome, type 2 DM, HT, and CVD are elevated in both genders. Central obesity is assessed by measuring waist circumference.

Sarcopenic obesity is defined as the combination of obesity and sarcopenia, which is the loss of muscle mass and strength. It can occur at any age, and its mechanism is associated with muscle catabolism due to inflammation and/or physical inactivity.

Micronutrient Disturbances

Micronutrients include vitamins and trace elements. Vitamins are essential organic molecules required in any diet, even in relatively small amounts. In disease conditions, vitamin requirements increase due to heightened metabolic demands and losses. The inflammatory response can complicate the evaluation of vitamin levels; therefore, C-reactive protein (CRP) levels should be checked simultaneously.[7]

Trace elements are fundamental components that play key roles in metabolic pathways, medical nutrition therapy, antioxidation, and immune function. These include iron, zinc, selenium, iodine, copper, chromium, manganese, and molybdenum. Both vitamins and trace elements should be administered separately to patients.[8]

Other nutrition-related conditions include sarcopenia, frailty, and refeeding syndrome, according to ESPEN.[9]

Sarcopenia

Sarcopenia is characterized by a progressive loss of skeletal muscle mass and function. Although various criteria have been used to define sarcopenia, the first global conceptual definition was provided by the Global Leadership Initiative on Sarcopenia (GLIS), formed by international associations.[10] While sarcopenia can occur before frailty during aging (primary sarcopenia), it may also result from pathogenic mechanisms related to disease, physical inactivity, or nutritional deficiencies (e.g., protein deficiency). Sarcopenia is generally evaluated in three stages:[11,12]

1. Evaluation of muscle strength
2. Evaluation of muscle mass
3. Evaluation of physical performance

Table 1. Obesity classification according to BMI

BMI (kg/m²)	Class
≤ 18.5	Weak
18.5- <25	Normal
25-<30	Overweight
30-<35	Class 1 obesity
35-<40	Class 2 obesity
≤ 40	Class 3 obesity (morbid, excess or severe)

BMI, Body Mass Index.

Frailty

Frailty is "a clinical syndrome with a distinct phenotype associated with a decreased reserve and high vulnerability to stressors and with risk of adverse outcomes including mortality."[12] The frailty construct includes several domains: physical, cognitive, psychosocial, and emotional. Frailty is not solely focused on myopenia. There are two methods to assess frailty: questionnaires and objective tests.[12] The relationship between frailty and sarcopenia is illustrated in Figure 1.

Refeeding Syndrome

Refeeding syndrome is a severe deterioration of electrolyte and fluid balance in malnourished individuals when feeding (oral, enteral, or parenteral nutrition) is initiated too aggressively after a period of undernutrition.[1]

NUTRITION-RELATED CONDITIONS IN IBD

Malnutrition in IBD

The pathomechanisms of malnutrition in IBD are illustrated in Figure 2.[13] The prevalence of malnutrition among IBD patients is quite high, ranging from 20–85%.[4,13–16] Malnutrition disproportionately affects hospitalized patients with IBD.[16] The prevalence of weight loss has been reported as 70–80% in inpatients.[13]

Malnutrition is more frequently observed in patients with Crohn's disease (CD). Approximately 30–75% of patients with CD and 18–62% of patients with ulcerative colitis (UC) are malnourished. Disease location, severity, and the evaluation tool used all contribute to this variation.[4] Protein-energy malnutrition and micronutrient deficiencies are more common in CD patients with small bowel involvement, fistulizing disease, or a history of bowel resection. In patients with UC, there is a rapid deterioration in nutritional status during acute attacks and hospitalization.[15]

However, anthropometric measurements, body composition analysis, and sarcopenia assessments were conducted in a single-center cross-sectional analysis of 406 adult IBD patients [336 (82.76%) with UC and 70 (17.24%) with CD; mean age 40.56 ± 13.67 years; 215 (52.95%) males]. Contrary to popular belief, the prevalence of malnutrition and sarcopenia was found to be similar in UC and CD patients [24.40% (n=82) and 28.57% (n=20), respectively (p=0.46)].[16]

MAIN POINTS

- **Malnutrition, obesity, sarcopenia, and frailty are highly prevalent in IBD patients,** with malnutrition affecting up to 85% and sarcopenia present in 17% of cases, necessitating routine nutritional screening and assessment in both outpatient and inpatient settings.
- **Nutritional therapy plays a dual role in IBD management,** serving both as supportive care for correcting deficiencies and as a primary therapeutic intervention, particularly through exclusive enteral nutrition and partial enteral nutrition.
- **The Mediterranean diet is recommended for patients in remission,** while no single diet has been universally accepted for inducing remission in active IBD; however, CDED, SCD, and other exclusion diets may aid symptom control in select cases.
- **Enteral nutrition is preferred when oral intake is insufficient,** and parenteral nutrition is indicated in specific clinical conditions such as intestinal failure, bowel obstruction, or intra-abdominal complications.
- **Multidisciplinary nutritional management involving physicians, nurses, and dietitians is essential** to ensure individualized care, optimize treatment outcomes, and improve quality of life in patients with IBD.

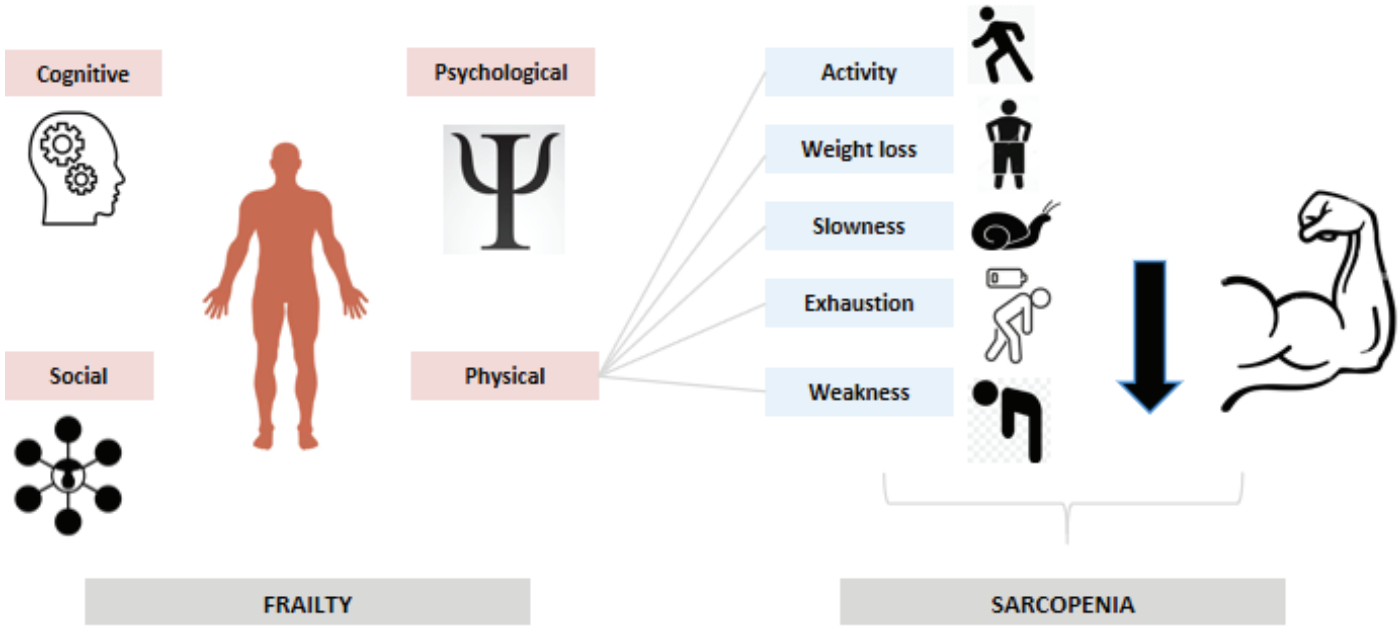

Figure 1. Overview of the Concept of Frailty and Sarcopenia[12]

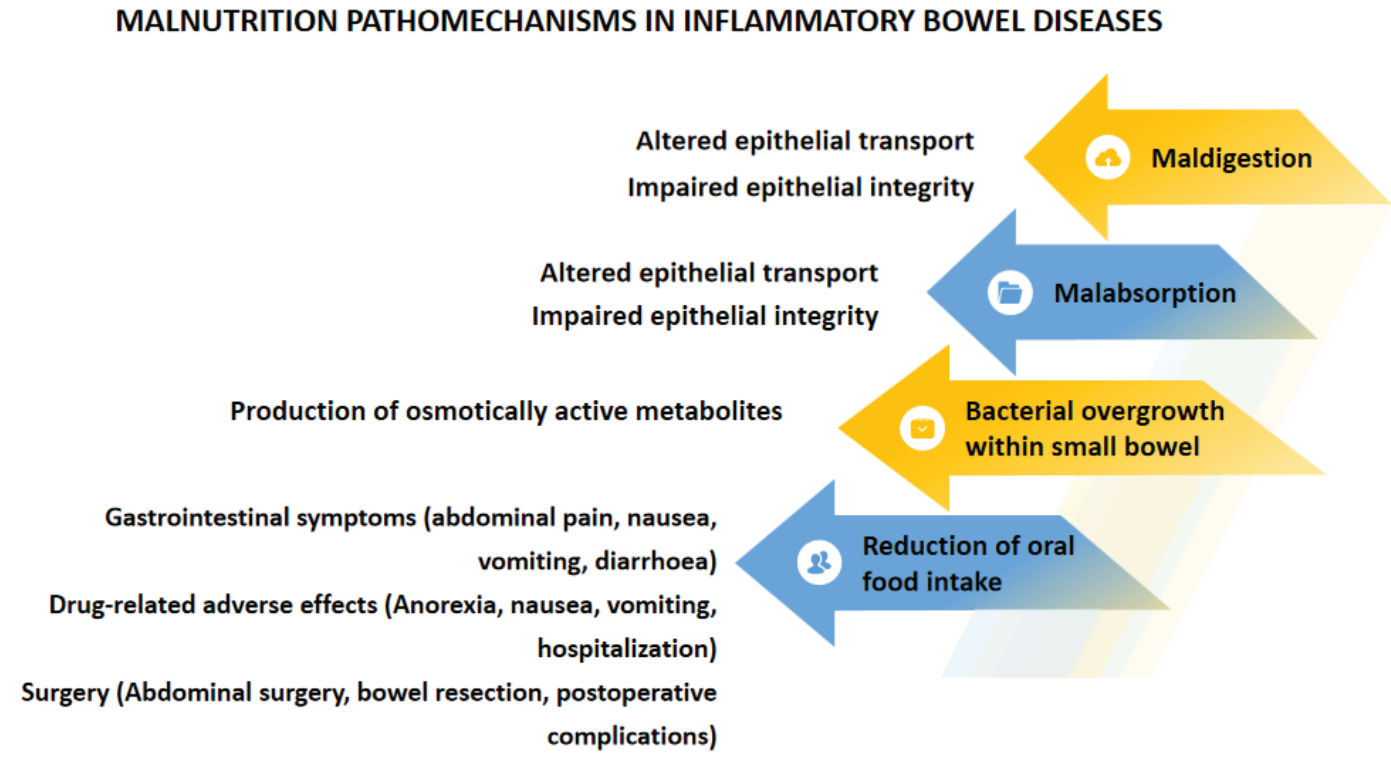

Figure 2. Pathomechanisms of Malnutrition in IBD[15]

Malnutrition in IBD patients has several negative consequences. These include a higher probability of disease exacerbation, frequent hospitalizations, and the development of severe infections.[17] Malnutrition is also a significant risk factor for venous thromboembolism, non-elective surgery, more frequent and severe postoperative complications, increased mortality, and higher infection rates in hospitalized patients.[18]

In a recent observational study, patients with IBD and protein-calorie malnutrition (PCM) who received nutritional support were analyzed using data from the Nationwide Readmissions Database from 2010 to 2018. The study included 1,216,033 patients (1,820,023 hospitalizations) with CD, 832,931 patients (1,089,853 hospitalizations) with UC, and 240,488,656 patients (321,220,427 hospitalizations) without IBD.

IBD patients were found to be 2.9–3.1 times more likely to have PCM than non-IBD patients. Malnutrition in hospitalized IBD patients was a significant contributor to readmission, mortality, length of stay, and healthcare costs. Nutritional support given to IBD patients reduced the risk of readmission.[19]

Changes in body composition, such as alterations in the fat mass/lean mass ratio, loss of lean muscle mass, and development of sarcopenia, are outcomes of malnutrition in IBD patients. Additionally, micronutrient deficiencies—including iron, calcium, zinc, magnesium, selenium, water-soluble vitamins (B12, folic acid), and fat-soluble vitamins (A, D, and K)—are also commonly observed.[4,13,18]

Overweight and Obesity in IBD

According to WHO data, as of 2022, 1 in 8 people globally is living with obesity. In the same year, 2.5 billion people worldwide were overweight, and 890 million were obese.[20] As global obesity rates rise, the proportion of obese patients with IBD is also increasing. Overweight, obesity, and severe obesity are observed in 20–40%, 15–40%, and 2–3.2% of patients with IBD, respectively.[21]

Obesity is a chronic, low-grade inflammatory condition, and adipose tissue is a key driver of immune-mediated inflammation.[22] Although findings are mixed, obesity in IBD has been associated with poorer disease outcomes, reduced remission rates, lower quality of life, increased healthcare utilization, and a higher risk of surgery.[23]

Sarcopenia and Frailty in IBD

In a systematic review of 35 studies evaluating sarcopenia in IBD, the prevalence of myopenia was 42%, pre-sarcopenia 34%, and sarcopenia 17% among adult patients.[24] Sarcopenia shows high prevalence rates in both CD (52%) and UC (37%). In IBD, sarcopenia significantly increases the risk of surgery, postoperative complications, prolonged hospitalization, rehospitalization, impaired quality of life, and poor response to biologic therapy.[25]

The prevalence of frailty was found to be 18% (95% CI: 12%–24%) in a meta-analysis of 1,495,695 IBD patients.[12] Another recent meta-analysis of 23 observational studies involving 1,893,448 adult IBD patients reported a similar frailty prevalence of 18% (95% CI: 12.4%–25.6%).[26]

Frailty is associated with adverse IBD-related outcomes, including hospitalizations, infection-related admissions following treatment, increased surgical interventions and complications, postoperative morbidity, and mortality.[12,26]

Malnutrition (20–85%), obesity (15–40%), sarcopenia (17%), and frailty (18%) are commonly observed in patients with IBD.

CLINICAL NUTRITIONAL MANAGEMENT IN IBD

Clinical nutritional management can be evaluated in two groups:

1. Nutritional Support Treatment
2. Primary Nutritional Treatment

NUTRITIONAL SUPPORT TREATMENT

All IBD patients should undergo a nutritional evaluation. The steps of this evaluation are shown in Figure 3.

Nutritional Screening and Evaluation

Nutritional screening is the first step in evaluating an IBD patient who may be at risk of malnutrition. In contrast, nutritional assessment is a more detailed process applied to at-risk patients to determine their actual nutritional status.[27] All IBD patients should be nutritionally screened to detect existing or potential malnutrition using nutritional screening tools recommended by ESPEN.[13,16,27] Malnutrition-related findings from medical history and physical examination are listed in Table 2.[27]

The Malnutrition Universal Screening Tool (MUST) and the Nutritional Risk Score 2002 (NRS 2002), though not specific to IBD, are particularly recommended.[13,18,27] Some tools have been developed specifically for IBD patients, including the IBD-specific Nutrition Self-Screening

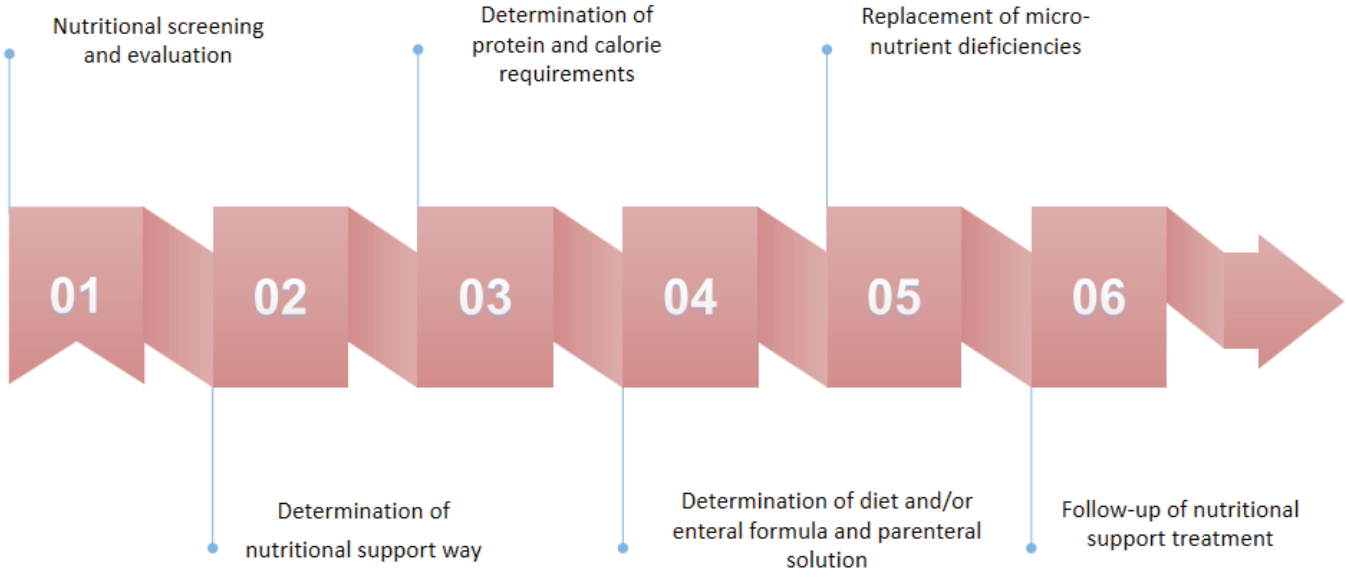

Figure 3. Steps of Nutritional Support Treatment in IBD[26]

Table 2. Malnutrition-Related Findings in Patients with IBD[27]

Significant weight loss, anorexia, nausea, vomiting – *Carbohydrates, Fats, Proteins*
Delayed milestones – *Carbohydrates, Fats, Proteins*
Oral ulcers – *Vitamin B complex*
Numbness, tingling sensation, burning, reduced sensations, gait disturbance – *Vitamin B complex, Vitamin B12, Vitamin E*
Bleeding tendencies, bleeding gums, petechiae, ecchymosis – *Vitamin C, Vitamin K*
Night blindness, dryness of eyes – *Vitamin A*
Disturbed sense of smell and taste – *Vitamin B complex, Zinc*
Poor wound healing – *Vitamin C, Zinc*
Fatigue, dyspnea on exertion, restless leg syndrome – *Iron, Vitamin B12, Folic Acid*
Body aches, muscle cramps, bone pain, fractures with minimal trauma – *Calcium, Vitamin D, Magnesium, Phosphorus*
Infertility – *Iron, Zinc, Selenium*

IBD, İnflammatory Bowel Disease.

Tool and the Saskatchewan Inflammatory Bowel Disease–Nutrition Risk Tool; however, these tools have not been validated in Turkiye.[28,29]

Nutritional assessment is performed for patients found to be at risk during screening. It includes patient history, food/nutrition-related history, anthropometric measurements, nutrition-focused physical findings, biochemical data, and disease-specific tests.[13,27] Taking a detailed food and nutrition history is particularly important. Unfortunately, the clinical nutrition training of physicians, including gastroenterologists, is often inadequate; therefore, support should be sought from dietitians, especially those specialized in IBD.[27]

Anthropometric measurements include BMI, mid-upper arm circumference (MUAC), mid-upper arm muscle circumference (MUAMC), skinfold thickness, and waist circumference.

The Subjective Global Assessment (SGA) is a nutritional assessment tool in which various patient parameters are scored from 1 to 7. Nutritional status is categorized as well-nourished, moderately malnourished, or severely malnourished. SGA is an inexpensive, rapid, and easy-to-administer tool. The seven-point SGA is also commonly used.[13,27]

Body composition can be measured using bioelectrical impedance analysis or radiologic methods such as dual-energy X-ray absorptiometry (DEXA),[30] magnetic resonance imaging (MRI),[31] ultrasound,[32] and computed tomography (CT).[33] DEXA is considered the gold standard for body composition analysis. However, routine use in clinical practice is not recommended due to the cost and the need for specialized equipment and trained personnel.

In clinical practice, sarcopenia is assessed using a dynamometer to evaluate handgrip strength. Other tests to assess physical performance include the 30-second chair test, gait speed, short physical performance battery (a combination of gait speed, balance test, and repeated chair stand test), stair climb test, timed up and go test, and 6-minute walk test. Radiologic parameters such as total psoas muscle area, appendicular skeletal muscle index, and height-adjusted appendicular skeletal muscle mass can also be used to diagnose sarcopenia.[34]

A complete blood count, albumin, CRP, and micronutrient levels should be routinely checked. If deficiencies are detected, they should be corrected and monitored.[17,26]

Malnutrition and sarcopenia should be screened for, and if necessary, evaluated and treated appropriately in patients with IBD. If left untreated, prognosis, complications, and quality of life will be negatively affected.

Determination of Nutritional Support Method

The determination of the nutritional support method for hospitalized patients with IBD is shown in Figure 4.[18] Enteral nutrition (EN) can be administered via a feeding tube or percutaneous access. If EN is delivered through jejunal access, a continuous EN pump should be used.

Determination of Protein and Calorie Requirements

The energy requirement for IBD patients is similar to that of the healthy population. However, protein requirements increase during active IBD, and intake should be raised to 1.2–1.5 g/kg/day in adults. When IBD is in remission, protein intake should align with general population guidelines at approximately 1 g/kg/day.[14,17]

Protein requirements are 1.2–1.5 g/kg, and calorie requirements are 30–35 kcal/kg/day in patients with active IBD.

Calorie requirements can be estimated at the bedside using a simple calculation (30–35 kcal/kg), or more precise formulas such as the Harris-Benedict or Schofield equations can be used in specific disease conditions. Exact energy requirements can be determined by indirect calorimetry.[14,17]

Determination of Diet and/or Enteral Nutrition and Parenteral Solution

When deciding on a diet to initiate, it is important to consider whether IBD is active or in remission. If IBD is in remission, the Mediterranean diet is advised for overall health. This diet is rich in fresh fruits and vegetables, complex carbohydrates, lean proteins, and monounsaturated fats. Consumption of ultra-processed foods, added sugars, and salt should be limited.[35]

There is currently no universally recommended "IBD diet" to induce remission in patients with active IBD.[17] No specific diet has been proven to prevent inflammatory attacks. However, a diet low in red and processed meat may help reduce UC flare-ups.[35]

A low-fiber diet, previously more commonly prescribed, may still be appropriate for patients experiencing acute attacks and worsening symptoms. Several dietary approaches—such as the Mediterranean diet, the specific carbohydrate diet, the anti-inflammatory diet for IBD, and the Crohn's Disease Exclusion Diet (CDED)—may be helpful in relieving symptoms in some IBD patients.[36,37] Other dietary strategies that exclude gluten, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs), as well as lactose, have also been tried in IBD. However, long-term use of a low FODMAP diet should be avoided, as it can alter the gut microbiota and reduce the production of short-chain fatty acids.[35,38] The contents of the recommended diets are shown in Table 3.

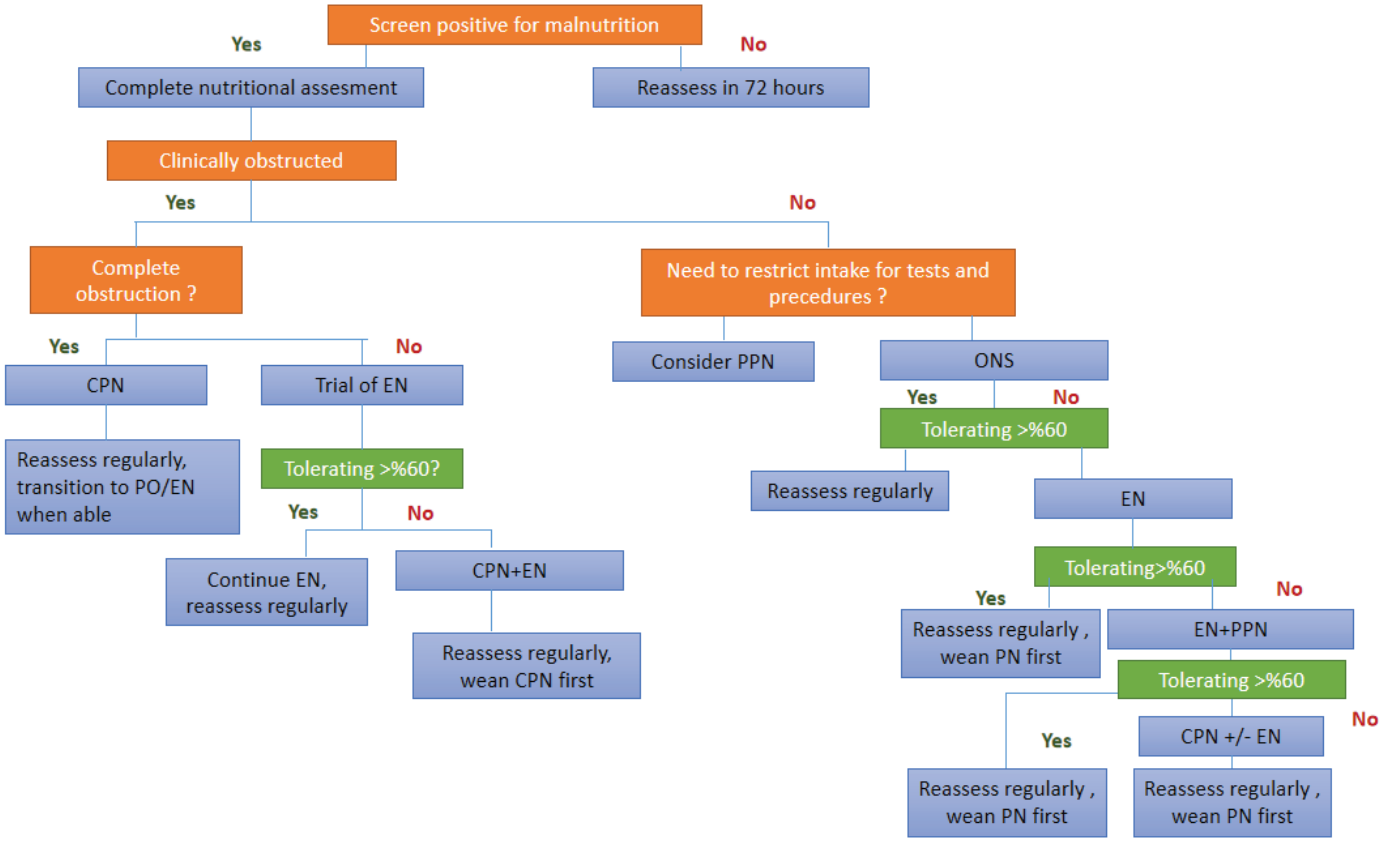

Figure 4. Determination of Nutritional Support Method in Hospitalized Patients with IBD[18]

Table 3. Diets Applied in Active IBD[35,38]

Diet	Rationale	Diet Description
Mediterranean Diet	A plant-based diet with limited animal protein has anti-inflammatory effects	High in vegetables, fruits, cereals, nuts, legumes, and unsaturated fats. Fish, poultry, and dairy are encouraged in moderation.
Specific Carbohydrate Diet	Undigested disaccharides and polysaccharides contribute to intestinal dysbiosis and inflammation	Includes fresh produce, unprocessed meats, nuts, some legumes, and healthy oils. Excludes grains, sugars (except honey), and most dairy products.
Anti-Inflammatory Diet for IBD	Certain carbohydrates in the intestinal lumen cause dysbiosis and inflammation	Emphasizes lean proteins, omega-3 fatty acids, and prebiotic/probiotic foods. Excludes gluten, potatoes, most dairy, corn, processed foods, and additives.
Crohn's Disease Exclusion Diet	Whole foods support gut integrity; harmful food components affecting the gut barrier or microbiota are restricted	Three-phase, step-down diet with partial enteral nutrition making up 50%–25% of calories. Five mandatory foods: chicken breast, eggs, potato, banana, and apple. Allowed foods include lean proteins, starchy vegetables, legumes, and whole grains. Restricted: wheat, dairy, and food additives.

IBD, İnflammatory Bowel Disease.

Symptomatic IBD patients with intestinal strictures may not tolerate plant-based foods such as raw vegetables and fruits. These foods should be thoroughly cooked and well chewed. Patients should avoid undigested fiber sources, including peeled apples, lettuce, broccoli, and corn.[2]

If IBD is in remission, the Mediterranean diet is advised for overall health. This diet is rich in fresh fruits and vegetables, complex carbohydrates, lean proteins, and monounsaturated fats. Consumption of ultra-processed foods, added sugars, and salt should be limited.

There is no universally recommended "IBD diet" to induce remission in patients with active IBD.

Several diets—such as the Mediterranean diet, specific carbohydrate diet, anti-inflammatory diet for IBD, and CDED—may be helpful in alleviating symptoms in IBD. Other dietary approaches that exclude gluten, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs), as well as lactose, have also been tried in IBD.

When patients are unable to meet adequate and necessary nutritional needs, the following methods may be used:

Table 4. The Types and Contents of Enteral Formulas

Enteral Formula Type	Polymeric Formulas	Oligomeric (Semi-elemental and Elemental) Formulas	Modular Formulas	Disease-Specific Formulas
Content	Contain 60% complex carbohydrates and polysaccharides, 15–25% whole protein, and 25–50% fat in the form of long-chain triglycerides. Available as standard, concentrated, high-protein, and fiber-enriched formulations.	**Semi-elemental:** Contain partially digested proteins such as oligo-, di-, and tripeptides, and medium-chain fatty acids. **Elemental:** Contain completely hydrolyzed macronutrients—amino acids, simple sugars, and low fat content.	Contain only isolated nutrients, such as proteins and carbohydrates.	Contain added therapeutic ingredients, such as transforming growth factor-β.

Oral Nutritional Supplements

Oral nutritional supplements are commonly used as the first step for both outpatient and hospitalized patients who require nutritional support.

Enteral Nutrition

Enteral nutrition is the preferred method when oral intake is inadequate. The aphorism "If you don't feed the patient, feed the intestines" should be kept in mind. However, EN is not recommended for patients with active or remissive ulcerative colitis (UC), as there is no supporting evidence for its efficacy in these cases.[38]

Enteral access routes include

- Nasogastric tube
- Nasojejunal tube
- Gastrostomy
  - Percutaneous, endoscopic, radiologic, and surgical approaches
- Jejunostomy
  - Percutaneous, endoscopic, radiologic, and surgical approaches

In patients with IBD, a standard polymeric formula with moderate fat content is preferred. Specific substrates such as glutamine and n-3 polyunsaturated fatty acids are not recommended for use in EN or PN in IBD patients.[17,35] The types and contents of enteral formulas are presented in Table 4.

Parenteral Nutrition

PN may be used to provide bowel rest as a bridge to surgical treatment in IBD patients with intra-abdominal abscesses and/or phlegmonous inflammation to reduce infection and inflammation. It is also recommended in cases of intestinal failure, bowel obstruction, anastomotic leak, gastrointestinal fistula, prolonged ileus, short bowel syndrome, or when oral intake and enteral access are not feasible or are contraindicated.[35,39]

In patients with high-output fistulas or poor wound healing in the postoperative period, protein requirements may be as high as 2.0–2.5 g/kg/day.

PN is recommended in cases of intra-abdominal abscess and/or phlegmonous inflammation, intestinal failure, bowel obstruction, anastomotic leak, gastrointestinal fistula, prolonged ileus, short bowel syndrome, and when oral intake and enteral access are not possible or are contraindicated.

Follow-up of Nutritional Support Treatment

PN and EN support require an expert dietitian who is part of the multidisciplinary nutrition team. The dietitian's role includes assisting with nutritional support, monitoring patients throughout the treatment period, educating patients on compliance with EN and PN, and guiding the transition back to oral intake.[35] Regular nutritional assessments and laboratory tests are necessary for all IBD patients.[13]

PRIMARY NUTRITIONAL THERAPY

Nutritional therapy not only improves the patient's nutritional status but also reduces intestinal inflammation, relieves symptoms, and promotes healing. It has been theorized that diet can improve mucosal immune dysfunction—triggered by the Western diet—by eliminating contributors to gut dysbiosis. The use of both exclusive enteral nutrition (EEN) and, as part of partial enteral nutrition (PEN), the CDED has gradually increased as primary treatment for induction of remission and/or maintenance therapy in children, and in some adults, with CD.[35,36,38]

Exclusive Enteral Nutrition

EEN is defined as the use of a complete nutritional formula as the sole dietary intake over a period of 6–8 weeks. The nutritional formula may be consumed orally or administered via enteral access. No additional oral food intake is permitted. Use of an elemental formula is not required; intact protein products may be used.

EEN is effective in approximately 80% of pediatric CD patients, showing significantly improved endoscopic mucosal healing compared to corticosteroids. It can be considered a corticosteroid-sparing bridge therapy.[17,18,35] EEN has also been shown to provide clinical and biochemical remission in adult patients with Crohn's disease when tolerated.[40,41]

Currently, pre-operative EEN is recommended to reduce postoperative complications.[35,42] EEN is effective for treating CD-related complications such as strictures, abscesses, and fistulas; however, treatment duration may be prolonged.[43] EEN can be combined with medical therapies. In particular, the combination of EEN with biologic agents has proven more effective than monotherapy.[44] Multiple potential mechanisms behind the effects of EEN are illustrated in Figure 5.[45]

EEN is defined as the use of a complete nutritional formula as the sole dietary intake over 6–8 weeks. Its effectiveness is higher in the pediatric age group with Crohn's disease; however, it may also play a role in achieving remission in adult CD patients when tolerated.

Partial Enteral Nutrition

PEN refers to the daily caloric intake partially met by enteral formula (50–80%), with the remainder provided through whole foods or a modified diet such as the CDED. The nutritional formula can be consumed

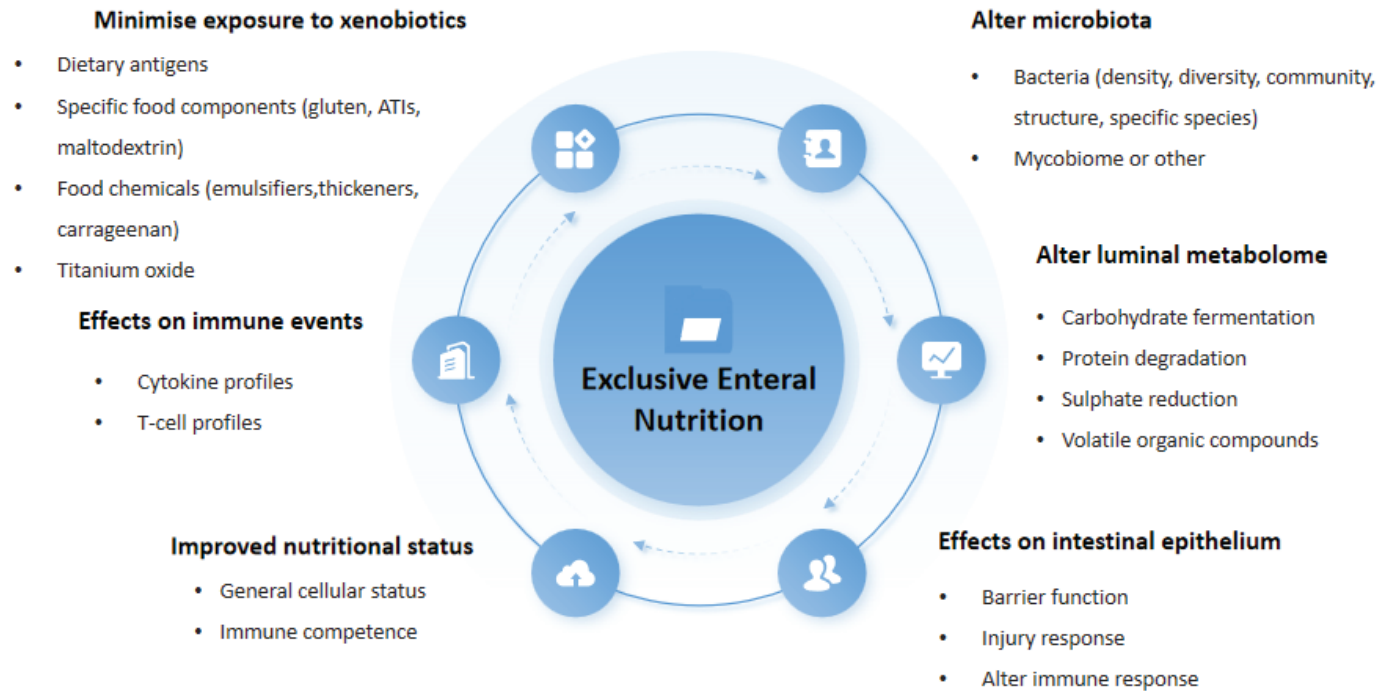

Figure 5. Mechanisms of Action of Exclusive Enteral Nutrition[45]

orally or administered via an enteral route. PEN may serve as an alternative for patients who cannot comply with EEN.

CDED is implemented in three phases:

- **Phase 1 (Weeks 1–6):** Approximately 50% of daily caloric intake is provided by enteral formula, alongside a diet low in saturated fat, fiber, and taurine.
- **Phase 2 (Weeks 7–12):** Use of enteral formula is reduced to 25%.
- **Phase 3 (Week 13 and beyond):** Continued dietary modification with 25% of caloric intake from formula.[17,18,35]

CDED may be an effective treatment for achieving clinical remission and endoscopic response in patients with mild to moderate Crohn's disease over the short term.

While PEN was previously recommended primarily for maintenance of remission in CD, a recent systematic review of controlled studies comparing PEN and EEN demonstrated that PEN is at least as effective as EEN in inducing remission.[46,47] PEN also contributes to the success of treatment with biologic agents.[48]

Microbiota Modulation

The microbiota plays a significant role in IBD. "Dysbiosis" refers to a reduction in the number, diversity, and stability of bacteria in the gut microbiota. Dysbiosis is observed in patients with IBD; however, it remains unclear whether dysbiosis is a cause or a consequence of the disease.

Microbiota modulation strategies include dietary interventions, probiotics, prebiotics, antibiotics, and fecal microbial transplantation. However, further studies and stronger evidence are needed before microbiota-based treatments can be routinely implemented in IBD management.[49]

Nutritional deficiencies resulting from IBD medications, as well as the nutritional approach to short bowel syndrome and pre-, peri-, and postoperative nutritional management, will be discussed in the relevant sections.

Consequently, the presence of malnutrition in IBD should be investigated in both outpatient clinics and hospitalized patients. When detected, an individualized nutritional approach should be designed, implemented, and closely monitored.

Nutritional therapy serves both as a supportive treatment for correcting deficiencies and as a primary treatment modality in IBD—for example, through the use of EEN and PEN.

The nutritional approach should be implemented by a multidisciplinary team that includes a physician, nurse, and dietitian.

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