

Diet and Nutrition in Crohn's Disease and Ulcerative Colitis

Important Questions – Real Answers



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Important Questions – Real Answers

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What is the importance of diet and nutrition in the therapy concept in patients with inflammatory bowel diseases (IBD)?

Crohn's disease and ulcerative colitis represent a special challenge for both the patient concerned with the choice of foods and for the practitioners of nutrition therapy seeking how to best advise them. Typical symptoms, such as digestive complaints, stool irregularities, diarrhea, abdominal pain, nausea and weight loss, have often been blamed on dietary factors, since they often occur after eating. As a result, both patients and their families are uncertain what they should eat and drink in order to both avoid an increase in symptoms and prevent nutritional deficiencies. A poor nutritional status has an unfavorable effect on the activity of the disease.

A comprehensive nutritional counseling and therapy program can go a long way to improving the quality of life in patients with Crohn's disease and ulcerative colitis. The belief that there is a generally applicable nutrition concept for patients with inflammatory bowel diseases, however, is incorrect. To be effective, nutrition therapy must first consider the individual requirements of the individual patient. Here, several important questions must be asked, and decisions made, prior to beginning therapy:

- Which inflammatory bowel disease is present: Crohn's disease or ulcerative colitis?
- What is the patient's current disease phase (acute flare or symptom-free interval)?
- Which segments of the digestive tract are affected?
- Has the digestive function been significantly impacted?
- What medications does the patient take?
- Does the patient report any individual nutritional intolerances?
- Have there been any disease complications?

Thus, each patient requires his or her own individualized nutrition plan. And, as the requirements in terms of nutrition and nutrition therapy evolve in response to changes in the person's illness, the nutrition plan will at times require revision to take these changes into consideration. The goal of nutrition therapy is both to react quickly to problems caused by incorrect or deficient nutrition and to help prevent disease-related symptoms.

1. How do Crohn's disease and ulcerative colitis affect the digestion?

1.1 Crohn's disease

Crohn's disease can affect any segment of the digestive tract from the mouth to the anus. The most common site of inflammation in this disorder, however, is the final segment of the small bowel (the terminal ileum) and the immediately following first part of the colon, or large intestine. The inflammatory changes in Crohn's disease affect all layers of the bowel wall. This explains the frequent formation of fistulae (figure 1).

Disease affecting the small bowel in patients with Crohn's disease may result in the inadequate absorption of nutrients. The consequences include weight loss or deficiencies of individual or many nutrients. Patients, especially those who have undergone surgery on the terminal ileum, may require regular, life-long replacement injections of vitamin B₁₂, usually at intervals of two to three months. If vitamin B₁₂ deficiency persists, patients develop pernicious anemia, a dangerous condition in which the number of red blood cells is reduced.

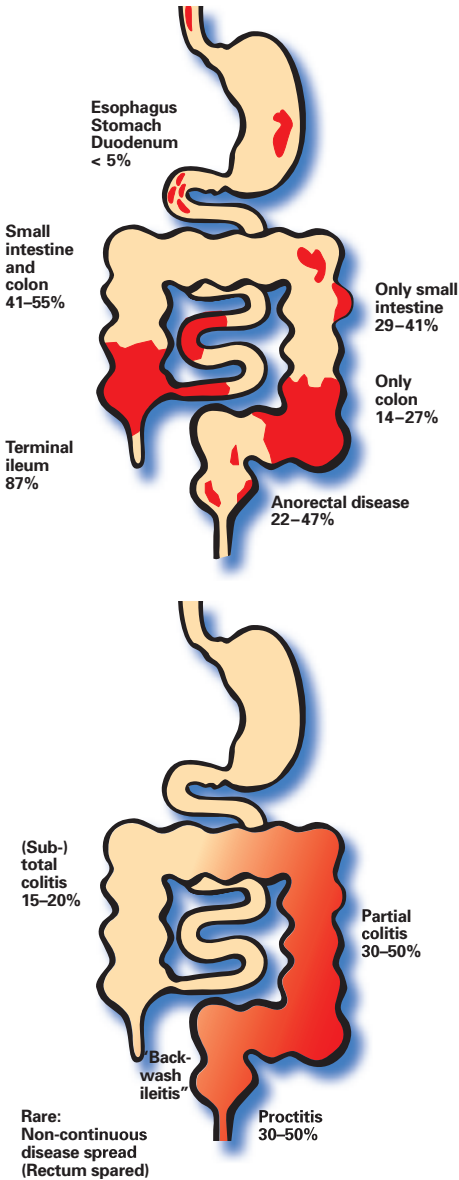


Figure 1: Localization and frequency of inflammation in Crohn's disease and ulcerative colitis

1.2 Ulcerative colitis

In ulcerative colitis, inflammation is restricted exclusively to the colon, or large bowel. During an acute disease flare the capacity of the colon to absorb water is usually severely reduced, which serves to further worsen the diarrhea. Because in ulcerative colitis only the colon is affected by the inflammatory process, nutritional deficiencies and associated symptoms are less common than with Crohn's disease. Also, unlike Crohn's disease, the inflammation in ulcerative colitis is limited to the mucosal layer. A common symptom is the occurrence of bloody diarrhea with admixtures of mucus (figure 2).

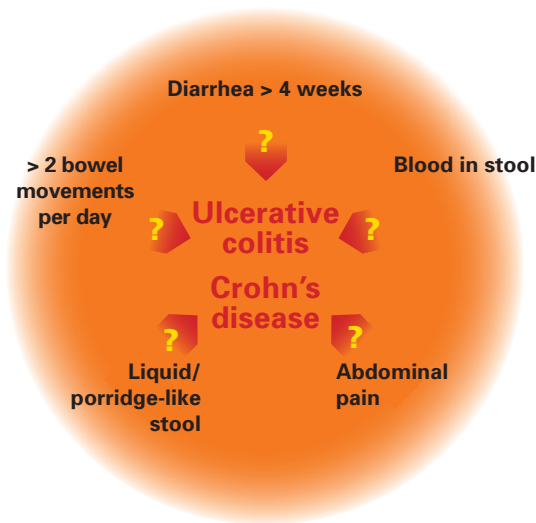


Figure 2: Symptoms that suggest inflammatory bowel diseases

2. Can the wrong diet trigger IBD?

Patients often ask whether individual nutritional or dietary factors are responsible for the development of inflammatory bowel diseases (IBD). The suspicion of a correlation is supported by the reported increase in the rate of IBD since the 1950's in Western industrialized nations. Factors that have been discussed in relation to this increased frequency of IBD since the end of World War II include the increased consumption of refined carbohydrates and chemically processed fats (trans fatty acids), the reduced consumption of dietary fiber, allergic reactions to baker's yeast, the replacement of human milk in



Figure 3: Inflammatory bowel diseases and nutrition: unsubstantiated correlations

the diet of infants and exposure to *Mycobacterium avium* paratuberculosis in inadequately pasteurized cow's milk. Current investigations are focusing on whether foods containing sulfur or sulfured additives are responsible for the inflammatory changes in ulcerative colitis. Convincing evidence for a possible role for nutritional or dietary factors in the development of either Crohn's disease or ulcerative colitis, despite the increasing number of cases and changed style of life and nutrition in modern industrial nations, has yet to be discovered (figure 3). Only in the case of breast-feeding has there been clear evidence that this may protect against the development of IBD.

3. Nutritional deficiencies in IBD:

How do they occur and what can I do?

During the course of their illness, a large number of patients with IBD experience either a general malnutrition or deficiencies of individual nutrients (table 1). Many IBD patients, especially those with Crohn's disease, are underweight and/or suffer from anemia. Low body weight and malnutrition, however, are associated with an increased risk for inflammatory flares and everything should be done to prevent them. Attention should be paid to a balanced diet and, when necessary, to nutrition therapy. Malnutrition and nutrient deficiencies in patients with IBD can be due to a wide range of causes. Potential causes for the development of malnutrition in inflammatory bowel diseases include:

- Reduced dietary intake
- Reduced absorption of nutrients in the small bowel (malabsorption) due to functional disturbances
- Increased bowel movements in cases of diarrhea with associated nutrient loss

- Interactions between pharmaceutical agents and nutrients
- Increased nutritional requirements during phases of active inflammation

Table 1: Frequency (in %) of nutrient deficiency or nutrient deficiency-associated findings in in- and outpatients with IBD

Nutrient	Crohn's disease		Ulcerative colitis	
	Inpatient	Outpatient	Inpatient	Outpatient
Weight loss	65–75	54	18–62	43
Hypalbuminemia ("Albumin deficiency")	25–80	0	25–50	n.s.
Anemia (various types)	60–80	54	66	n.s.
– Iron	25–50	37–53	81	n.s.
– Folate (folic acid)	56–62	10	30–41	n.s.
– Vitamin B ₁₂	48	3–4	5	n.s.
Vitamin A	11–50	n.s.	93	n.s.
Vitamin D	23–75	n.s.	35	n.s.
Calcium	13	n.s.	n.s.	n.s.
Magnesium	14–33	n.s.	n.s.	n.s.
Potassium	6–20	n.s.	n.s.	n.s.
Zinc	40	1	n.s.	n.s.

n.s. = not studied

Often responsible for nutritional deficiencies is a reduction in dietary intake. Patients often are reluctant to eat because the onset of symptoms, such as colic, has in the past been associated with eating. This is especially true in patients with disease affecting the terminal ileum.

A further cause may be dietary intolerances, such as lactose intolerance, especially during the active inflammatory phase. This may result in a narrow and unbalanced choice of foods.

A second factor to consider is the fact that, during an acute inflammatory flare, the bowel's capacity to absorb nutrients, especially the trace elements, such as iron and zinc, is disturbed or reduced (malabsorption).

In addition, during an acute inflammatory flare, proteins may be lost through the inflamed intestinal mucosal membrane into the bowel. This can result in a deficiency of various proteins in the blood, such as albumin (an important serum protein) and immunoglobulins (protein substances that contribute to the immunity). The consequences of albumin deficiency include edema, which is the accumulation of water in the legs. Furthermore, loss of blood occurring during an acute flare can result in anemia and depletion of the body's iron stores.

Patients with persistent diarrhea are especially at risk for excessive loss – and deficiency – of potassium, magnesium and zinc. Patients with steatorrhea, that is, excessive loss of fats with the stool, also lose the fat soluble vitamins A, D, E and K, and also vitamin B₁₂, which is particularly pronounced in patients with inflammation of the terminal ileum or those who have undergone surgical removal of this bowel segment. This is compounded by the fact that each inflammatory flare, because of fever, infections and increased cell loss in the intestinal mucosal membrane, represents a stress situation for the body with significant increases in its needs for energy and nutrients. Patients with active fistula formation are exposed to an additional loss of zinc and magnesium in the fistular secretion.

Medications used in the treatment of inflammatory bowel diseases may also contribute to deficiencies of individual nutrients. For example, “cortisone” may contribute to the development of calcium and magnesium deficiencies and may have a negative effect on protein metabolism, resulting in a reduction in muscle mass. Sulfasalazine reduces the absorption of folate. The absorption of fat-soluble vitamins may be reduced by colestyramine,

which is used to bind bile acids. Therapy with antibiotics may have a negative effect on the vitamin K status.

4. What nutrients are especially critical and what foods contain them?

This section discusses the “micro-nutrients” that are especially critical for patients with IBD, their related deficiency symptoms and the foods which are rich in these nutrients. In addition, the options for targeting these deficiencies with special nutritional supplements are explained.

Vitamin A is especially crucial for vision (light/dark adaptation) as well as for wound healing and immune defenses in the skin, mucosal membrane, the lungs and the gastrointestinal tract. A frequent cause of vitamin A deficiency is a disturbance of lipid (fat) absorption. Foods rich in vitamin A include liver, butter, margarine, cheese, eel and tuna. Its precursor β -carotin is found in yellow and red fruits and vegetables, such as carrots, tomatoes, apricots etc. Supplementation with appropriate nutritional preparations, however, should always be monitored by a physician and should not be started in pregnant women or those with liver disease.

Vitamin B₁₂ plays an important role in cell growth and division, and in the formation of red blood cells. Typical deficiency symptoms include anemia and psychic changes. Long-standing vitamin B₁₂ deficiency can cause permanent damage to the nervous system. Deficits in this vitamin are particularly common after surgical removal of segments of the distal small bowel, since it is only here that vitamin B₁₂ can be absorbed. Bacterial overgrowth in the bowel and the formation of fistulae can also contribute to vitamin B₁₂ deficiency. Sufficient

amounts of vitamin B₁₂ are found in foods derived from animals, including fish, milk and other dairy products, and in pickled vegetables, such as sauerkraut. Resection or permanent damage (e.g. due to inflammation) to the segments of the gastrointestinal tract responsible for vitamin B₁₂ absorption (stomach, terminal ileum) makes it impossible to remedy this deficiency using oral nutritional supplements. In these cases, regular injections of vitamin B₁₂ by the treating physician are necessary.

Vitamin D plays a central role in bone metabolism. Disturbances of bone metabolism are associated with pain and demineralization of the bones and with muscle pains. Typical syndromes associated with vitamin D deficiency include rickets in children, osteomalacia (softening of the bones) in adults, and osteoporosis. In patients with IBD, vitamin D deficiency can be caused by reduced lipid absorption. Vitamin D is contained in fatty fish (herring, mackerel), liver, vitamin-D fortified margarines and egg yolk. The body itself produces vitamin D in response to sunlight. Because excessive amounts of supplemented vitamin D can be dangerous, supplementation with appropriate nutrient preparations should always be monitored by a physician.

Vitamin K is well known to be required for coagulation (clotting) of the blood; it is also essential for normal bone metabolism. Vitamin K deficiency leads to abnormal coagulation, mucosal bleeding and disturbances of bone formation with an increased risk for fracture (osteoporosis). Because vitamin K is produced in large quantities by the intestinal flora, deficiency of this vitamin can be caused by treatment with antibiotics. Foods containing vitamin K include green vegetables, milk and dairy products, red meat, eggs, grains and fruit. It is degraded by exposure to light. The type and dose of dietary supplementation with vitamin K is dependent on the cause and

severity of the deficiency. It should be ordered by the treating physician.

Folate is essential for the formation of red blood cells and for normal cell division and reproduction. It is closely associated with vitamin B₁₂ and iron. Symptoms of folate deficiency thus include anemia (megaloblastic anemia), bleeding in the mucous membranes, reduced immunity, danger of fetal malformations (neural tube defects), and risk of colon cancer. The long-term use of certain medications, such as sulfasalazine, can cause folate deficiency. The risk of folate deficiency is also associated with increased consumption of alcohol. Folate is contained in wheat germ, soybeans, certain vegetables, such as tomatoes, cabbage, spinach and cucumbers, certain fruits, such as oranges and grapes, as well as in breads and other products backed with whole wheat flour and in potatoes, meat, liver, milk and dairy products, and in eggs. Because high doses of folate can mask a vitamin B₁₂ deficiency, the regular intake of folate in dietary preparations should be restricted to a folate equivalent of 1000 µg per day or less and be discussed with your treating physician.

Iron is a component of hemoglobin, the red pigment of red blood cells that is responsible for the transport of oxygen in the blood, and is also essential for the proper function of the immune system. Manifest iron deficiency leading to anemia is associated with a number of typical *symptoms*, including reduced stamina, fatigue, headache, dizziness, increased heart rate (tachycardia) and shortness of breath (exertional and resting dyspnea). Many patients experience non-hematological symptoms even before the development of anemia. These symptoms of latent iron deficiency include hair loss, paresthesias (bothersome, sometimes painful sensations such as tingling, numbness or “falling asleep”) of the hands and

feet, a reduction in cognitive functions, and a statistically significant association with the restless legs syndrome. All of these symptoms significantly impair patients' quality of life, with time lost from work and even hospitalizations. Patients with chronic diseases, such as Crohn's disease or ulcerative colitis, are especially at risk of developing iron deficiency and, if it is allowed to progress, anemia. Based on the findings of numerous research studies, it is estimated to up to two-thirds of patients with IBD suffer from iron deficiency.

There are three main causes for iron deficiency in patients with chronic inflammatory diseases:

- Inflammation impacts the iron stores and prevents normal absorption of iron in the bowel (functional iron deficiency)
- The disease itself is responsible for the iron deficiency, e.g. due to bleeding or the destruction of hematopoietic cells (the cells in the bone marrow from which red blood cells are derived; disease-related iron deficiency)
- Inadequate iron intake in the diet (alimentary iron deficiency)

The warning signs of iron deficiency are often overlooked. They are often non-specific and the body has already been weakened by the disease itself. If iron deficiency is not treated with iron therapy, patients can develop anemia. This, together with the chronic disease, can further significantly impact, even endanger, patients' health and quality of life. This is particularly an issue for patients with cancer or with diseases of the heart or kidneys. Prompt correction of iron deficiency is therefore of prime importance.

The bowel's ability to absorb iron is promoted by the simultaneous intake of vitamin C and foods rich in this vitamin, such as citrus fruits. Certain medications may re-

duce iron absorption, including salicylates, antacids and ion exchangers. Iron absorption is also inhibited by phytates (substances contained in whole grain products and legumes), oxalic acid (contained in rhubarb, beets, spinach, cocoa, chocolate), as well as calcium and dairy products.

Because of the potential side effects, such as diarrhea, abdominal pain, vomiting, constipation and black stools, it is a general rule that oral iron preparations should not be used in patients with inflammatory bowel diseases. *Only the intravenous administration of iron by a physician is adequate for replacement of significant losses and for effective filling of the body's depleted iron stores.*

Magnesium is required for energy and electrolyte metabolism and for muscle contraction. In magnesium deficiency, potassium ions pour from the cells as through a sieve and are lost with the urine. The consequences include disturbances in the excitability of cardiac and skeletal muscle, which often first manifest in the form of cramps in the calves at night. Magnesium deficiency symptoms are frequently seen in patients with diarrhea (especially if it is chronic) and fistulae. In addition, cortisone preparations (e.g. prednisone) and diuretics (medications that promote urine formation), when used for a long period, may cause magnesium deficiency due to an increased urinary excretion of magnesium. Whole grain cereal products, long-grain rice, milk and dairy products, green vegetables, liver, poultry, fish, soybeans, berries, oranges and bananas are good sources of dietary magnesium. Dietary supplementation with magnesium preparations up to 350 mg is considered safe.

Calcium is required for bone metabolism, for the normal functioning of the heart, kidneys, lungs, nerves and muscles, and for blood coagulation (clotting) and cell division. Deficiency manifests itself, for example, in osteo-

porosis and muscle cramps. Causes for calcium deficiency include a deficiency in albumin (the transport protein for calcium in the blood), diarrhea, fistula formation, a disturbance in lipid absorption, vitamin D deficiency and the long-term use of cortisone preparations, which inhibit absorption in the bowel and increase excretion through the kidney. Patients requiring long-term treatment with cortisone preparations should assure a regular supplementation of calcium (1000–1500 mg/day) and vitamin D (500–2000 IU/day) in combination with other nutrients that promote healthy bone metabolism, such as vitamins C and K, and zinc. This is especially true in patients with lactose intolerance (lactose malabsorption) who consume a diet low in lactose. Calcium is present in large amounts in milk and dairy products, as well as in some varieties of vegetables (broccoli, cabbage, fennel, leeks), in high-calcium mineral waters (> 300 mg/liter) and in sesame. The guidelines of professional societies recommend a daily calcium intake of 1000 mg, a third of which amount is provided with a single slice of hard cheese. Calcium intake should be spread over several meals. A light late meal rich in calcium (cheese sandwich, yoghurt etc.) reduces the process of bone destruction that is especially pronounced at night. Supplementation with nutritional preparations should always be discussed with your treating physician. Calcium preparations should always be taken between meals and never taken on an empty stomach.

Potassium is important for the energy and electrolyte metabolism, for heart and muscle function, for the electrical conduction of nerves and for regulation of the blood pressure. Potassium deficiency can present with muscle weakness, constipation, bowel paralysis or disturbances of cardiac function. **Potassium losses are frequently caused by diarrhea.** Foods rich in potassium include bananas, potatoes, avocados, apricots, dried

fruits, spinach, mushrooms, skim milk products, cocoa drinks and whole grain products. Excessive washing of vegetables and cooking with too much liquid reduces the potassium content of foods. An adult's recommended daily allowance stands at about 2000 mg. Here, too, supplementation with nutritional preparations should occur only after consulting the treating physician.

Zinc, because of its wide range of functions in a variety of biological processes in the human body, is one of the most important trace elements. Zinc is necessary for growth, cell division, sexual development, regenerative processes, night vision, the immune system and immune defenses, wound healing, skin and hair, the sense of taste and the appetite. It also has antioxidant properties. Zinc deficiency leads to growth retardation and skeletal deformities, disorders of sexual maturation, erectile dysfunction, malnutrition, hair loss, dermatitis (skin inflammation), weight loss, disturbances of taste, night blindness, increased susceptibility to infection, diarrhea and abnormal healing of wounds and fistulae.

Patients with IBD are especially at risk for the development of zinc deficiency since several possible causative factors may coincide. On the one hand, there is increased loss due to intestinal bleeding, diarrhea, fistulae and chronic inflammation; on the other, zinc intake may be reduced due to inadequate dietary consumption and/or malabsorption in the bowel associated with an albumin deficiency. As with magnesium and calcium, the long-term use of cortisone preparations can result in an increased renal excretion of zinc, leading to deficiency. It is thus especially important that patients with IBD receive adequate zinc: This trace element has a positive effect on the inflammatory process and strengthens the immunity. For example, diarrhea refractory to treatment may often be due to zinc deficiency; zinc is lost to a great extent with the stool. With zinc replacement, how-

ever, the diarrhea often improves rapidly. Zinc deficiency is more frequently encountered in patients with Crohn's disease than in those with ulcerative colitis. Foods rich in zinc include beef, pork, poultry, eggs, milk, cheese, oysters, grain sprouts, poppy seeds, sunflower seeds, liver, wheat, oats, Brazil nuts, cashews and cocoa.

Zinc deficiency in patients with IBD should be counteracted by zinc replacement in the form of tablets/capsules or parenteral (intravenous) nutrition. Not all zinc preparations are absorbed equally well by the body. This is due to the fact that there are both organic and inorganic zinc compounds. Organic zinc compounds, such as zinc-histidine, are more reliably absorbed and utilized by the body than are the inorganic compounds. Because of potential interactions with the body's iron and copper metabolism, the intake of zinc preparations with a zinc content above 30 mg should only be done under the supervision of a physician. **In addition, it is important that the zinc preparation be taken on an empty stomach at least one hour before the next meal.** Because of interactions with the copper metabolism, patients receiving long-term zinc supplementation should have regular monitoring of the copper level.

As a general rule, because of potential side effects and interaction with other nutrients, the use of mineral, vitamin and trace element preparations should always be discussed with your treating physician. Special care should always be exercised when multivitamin and mineral preparations are combined with other preparations with the goal of dietary supplementation. In cases of extensive malnutrition with weight loss, a comprehensive consultation with a dietician and the use of artificial nutrition in the form of specially formulated liquid preparations, tube feedings or infusion therapy are essential.

5. How can I adapt my diet to the different disease phases?

5.1 Diet during an acute inflammatory flare

Although there are no general nutritional recommendations for patients with Crohn's disease or ulcerative colitis, nutritional therapy has distinct advantages for patients experiencing an acute inflammatory flare. The primary goal is to prevent malnutrition before it starts. A first requirement, however, is to determine the degree to which the bowel can tolerate the presence of food, which depends on the extent and severity of the inflammation and patient's other symptoms. During mild inflammatory flares or during remission (the phase in which the inflammation subsides), it may be sufficient to eat according to the guidelines of a light full diet (see chapter 5.2). If a light full diet is not sufficient to maintain patients' nutritional status, an alternative is the use of special high-calorie liquid diets (formula feeding). If malnutrition has set in, the professional societies recommend the additional intake of about 500 kcal per day using these formula diets.

Patients with severe diarrhea must assure adequate fluid intake. Non-carbonated water and tea are generally well tolerated. Juices (especially made from citrus fruits), carbonated beverages, and strong coffee and tea are usually less well tolerated. Serious losses of fluid and electrolytes should be replaced with a solution made according to the criteria of the World Health Organization (WHO). This solution contains sodium, potassium, chloride, citrate, bicarbonate and glucose in amounts best suited for fluid replacement.

In very severe inflammatory flares, patients may require to be maintained on parenteral nutrition for several weeks. If possible, nutritional intake through the bowel,

either as oral liquid diet or tube feedings, should be preferred to nutrition provided by intravenous infusion.

5.2 Diet as the acute flare resolves

Once the signs of inflammation begin to subside, patients can resume a normal diet. There is no firm evidence that patients benefit from a gradual building up of the diet. Experience, however, would suggest that a step-wise progression to a normal full diet makes sense, especially from a psychological point of view, in order to reduce patients' frequent anxiety about resuming a normal diet.

It is useful to begin with easily digested foods high in carbohydrates, such as zwieback, oat or rice meal and low-fat broths. If these foods are well tolerated, the next step adds white bread, jams, honey, strained and cooked fruit, diluted fruit juices, strained and boiled soft vegetables (e.g. carrots, spinach), cooked and strained lean meat with a low-fat sauce, rice, low-fat mashed potatoes, pasta, porridge made with skimmed milk (0.3%) and low-fat curds. Patients should also divide their food intake over several small meals (about five).

In the next step, patients' menus can be further advanced with the addition of some fats (spreads and for cooking), low-fat dairy products (1.5%; caution with lactose intolerance), reduced fat luncheon meats, lean fish, low-fat bakery items, stewed fruits and well-tolerated vegetables (e.g. cauliflower, celery, zucchini, young kohlrabi etc.). During this period, patients should still avoid raw produce, including lettuce and uncooked fruit.

If patients continue to tolerate the dietary progression, they can be advanced to a "light full diet", always considering patients' individual nutritional intolerances, such as lactose intolerance. The principles of light full diet are presented in tables 2 and 3. The food choices permitted

according to light full diet are especially suitable in cases in which there remains uncertainty about what foods can be eaten. As the patient becomes increasingly free of symptoms, remaining restrictions can be reduced, while still being guided by individual tolerances. General statements to avoid certain foods are not useful.

Although patients with IBD usually report intolerances of individual foods more frequently than do healthy persons, recent studies have found that classical food allergies do not occur more frequently than in the general population. Symptoms may, however, be triggered by individual intolerances: Experience has shown that persons with digestive disorders tend to react with bloating, diarrhea and pain to coarsely milled grains and nuts and products made from them, as well as vegetables of the cabbage family, legumes, fatty and fried foods, fruits with hard peels (plums, gooseberries etc.), vegetables cut into large chunks, vegetables pickled in vinegar, juices of acidic fruits. Products made for diabetics containing a large amount of fructose may make diarrhea worse. Foods enriched with sugar substitutes such as xylitol, sorbitol or isomaltose may cause digestive symptoms in sensitive persons.

IBD patients without stenoses (narrowing of the bowel) can eat high-fiber foods as part of a balanced healthy diet. In particular, so-called soluble fiber (contained in large amounts in fruit, vegetables, potatoes and whole grain products) binds water, thus helping to thicken the stool and reduce the frequency of bowel movements. Intestinal bacteria break down these substances into short chain fatty acids, which serve the intestinal mucosal membrane as a direct energy substrate and contribute to maintaining healthy bowel function. Whole grain products made from finely milled grain are generally better tolerated than those made from coarsely milled grains or those containing whole grains (table 2).

Table 2: Principles for developing a light, well-tolerated diet in disorders of the digestive tract

- Prefer low-fat foods and food preparation methods
- Begin with low-fiber foods but, as tolerated, gradually increase fiber content in the diet with vegetables, fruit, potatoes and finely milled whole grain products
- Avoid foods associated with gas production (e.g. cabbage)
- Avoid legumes
- Vegetables and fruit should be steamed rather than eaten raw
- Avoid foods known to be poorly tolerated
- Assure adequate hydration: Drink 2–3 liters of liquid per day
- Avoid carbonated beverages
- Avoid foods that are too cold, too hot or too spicy
- Six to seven small meals are better than three large ones
- Be relaxed when eating and chew your food well
- Pureed foods may be better tolerated

Table 3: Foods that can be selected for a light full diet

Usually better tolerated*:	Usually more difficult to digest:
<p>Meat Lean meat: beef, veal, pork, venison, lamb, poultry</p>	<p>Meat Fatty cuts of beef, veal, pork (¼ knuckles), venison, lamb, poultry, innards</p>
<p>Luncheon meats Lean cold veal or pork roast, cooked ham without fat, cured raw ham, corned beef, beef gelatin, beef sausage, poultry sausage, lean meat in soups; less frequently or in small amounts: boiled or cooked pork sausage (high fat content)</p>	<p>Luncheon meats Smoked meats; all fatty and heavily spiced sausages such as liverwurst, blood tongue, hardcheese, salami, raw ham and ready-to-eat meat or sausage salads</p>
<p>Fish Trout, pike, perch, rosefish, sole, codfish, flounder, pollack, shellfish, halibut</p>	<p>Fish Eel, salmon, carp, mackerel, tuna fish in oil, herring, canned fish, ready-to-eat fish salads</p>
<p>Eggs Up to 2–3 eggs per week in easily digested forms such as scrambled eggs, omelette or soft-boiled</p>	<p>Eggs Eggs in fatty or hard-to-digest forms, such as hard-boiled, sunny-side up, egg salad</p>
<p>Milk and dairy products Low-fat milk, buttermilk, sour milk, yoghurt and yoghurt products, sweet and sour cream in small amounts, curds and curd products, all mild cheeses up to 45% fat content, fresh cheese</p>	<p>Milk and dairy products Ice cream and cream in large amounts; all sharp cheese varieties</p>

Usually better tolerated*:	Usually more difficult to digest:
<p>Fats Butter, vegetable margarine, vegetable oil in moderation</p>	<p>Fats Bacon, lard, strongly heated and browned fats, mayonnaise in any form</p>
<p>Bulk foods and side-dishes Cooked potatoes, mashed potatoes, rice, milk rice, porridge, pasta, bleached flour, oatmeal, sago, barley</p>	<p>Bulk foods and side-dishes Potatoes baked in fat, French fries, potato salad, ready-to-eat müsli blends</p>
<p>Bread At first, multigrain bread, Graham crackers, zwieback, biscuits, crackers, white bread, toast bread; breads and rolls made from fine-milled whole grain flour as tolerated</p>	<p>Bread Fresh bread, all types of bread and rolls made from coarsely milled whole grain flour, especially with corns</p>
<p>Bakery items Low-fat items, such as yeast-risen pastries and biscuits; cookies, if low-fat</p>	<p>Bakery items Fatty and sweet items such as cream tortes, layered, filled or short-cake and anything baked with fat</p>
<p>Boiled vegetables Eggplant, cauliflower, green or wax beans, fennel, chicory, cucumbers, carrots, kohlrabi, beets, stock beets, spinach, celery, peeled tomatoes, asparagus, zucchini</p>	<p>Vegetables All vegetables, raw or as a salad; legumes, cucumbers, cabbage, red cabbage, green cabbage, Savoy cabbage, Brussels sprouts, peppers, mushrooms, leeks, onions, vegetables pickled in vinegar</p>
<p>Lettuce Head lettuce in low-fat oil and/or yoghurt dressings</p>	<p>Lettuce All other types of lettuce</p>
<p>Raw fruit Bananas, melons</p>	<p>Raw fruit All other types of fruit</p>
<p>Stewed fruits All steamed or cooked fruits except those known to be poorly tolerated; pineapple in moderation</p>	<p>Stewed fruits Gooseberries, currants, plums</p>
<p>Spices All green herbs (dried, fresh or frozen), nutmeg, caraway, bay leaves, juniper berries, pimento, vanilla, cinnamon, lemons, tomato paste, mustard in small amounts, use salt sparingly</p>	<p>Spices Horseradish, chives, onions, garlic, all sharp spices such as pepper, chili, paprika, curry; ready-to-eat sauce mixes should be highly diluted because of the high salt content</p>
<p>Beverages Non-carbonated mineral water, tea, juices diluted with water</p>	<p>Beverages Liquor, white and red wine, coffee, carbonated beverages</p>
<p>Snacks Low-fat baked snacks</p>	<p>Snacks and sweets Sweets in general, nuts, chips</p>

* This list is based on experience. In highly sensitive persons, even some of the foods listed in the column "usually better tolerated" may be problematic.

5.3 Diet during the inactive phase

It is important to remember that an acute inflammatory flare is not caused by “the wrong food or drink”. Many different factors are involved in the origin of the disease and the triggering of acute flares. Diet is only one of many factors being discussed in this regard. There is currently no scientifically proven evidence at this time that there is any special diet suitable for maintaining remission or prolonging the interval during which you are free of symptoms. However, because a good nutritional status may correlate with a low disease activity, it is important that patients in remission eat an adequate and balanced diet.

In assessing the nutritional status, the first piece of information is the body weight. A rapid assessment of the adequacy of body weight is provided by the so-called Body-Mass Index (BMI). Ideally, this number should be between 20 and 25 but should never fall below 18 (figure 4).

Formula for calculating BMI:

$$\text{BMI} = \frac{\text{Body mass in kilograms}}{\text{Body height in meter}^2}$$

Any undesired weight loss is a warning sign for malnutrition and should be investigated by your physician!

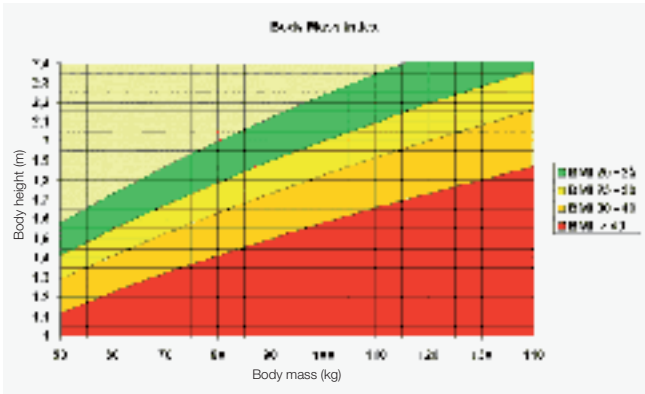


Figure 4: BMI table

6. Are there dietary factors that might prolong the inactive phase in IBD?

Many patients would prefer to reduce or even stop medication during symptom-free phases. Associated with this are questions regarding diet or nutritional factors that may help prolong such phases. The following sections discuss factors that in studies have shown some hope for positively influencing the length of remission.

6.1 Prebiotics, probiotics and synbiotics

Prebiotics are soluble nutrients (short-chain carbohydrates) that promote the growth and reproduction of useful bacteria (bifidobacteria, lactobacilli), thus exerting a positive influence on the intestinal flora.

Common substances used as prebiotics include oligosaccharides such as inulin, fructo-oligosaccharide (FOS) and galacto-oligosaccharide (GOS), which are not absorbed in the small bowel and thus reach the colon unchanged. In the colon, prebiotics are fermented by resident bacteria. Fermentation results in the formation of short-chain fatty acids (SCFA) and gases (CO_2 , H_2). The

fermentation of inulin and FOS results in formation of large amounts of butyrate, which is an essential growth factor for the mucosal membrane in the colon and serves as an important regulator of the local immune defenses. Another important aspect is the promotion of bifidobacteria and other non-pathogenic intestinal flora. This is important in preventing the overgrowth of pathogenic (disease-causing) microbes (table 4).

Although our understanding of the effects of prebiotics in the bowel is increasing, results of clinical studies have not yet shown clear and significant advantages in terms of health promotion associated with the use of prebiotics. Some preliminary studies have shown evidence that certain prebiotics may have an effect in maintaining remission, especially in ulcerative colitis. Prebiotics such as inulin, FOS and GOS are natural components of food. Inulin and FOS are found in chicory, artichokes, leeks, garlic, onions, wheat, rye and bananas. GOS are found in large concentrations in human milk. It is known that, in infants, GOS is a strong promoter of the growth of bifidobacteria and lactobacilli.

Probiotics are living microorganisms that, when ingested into the human body, produce health-promoting effects beyond their basic nutritional and physiological effects. In order to be classified as a probiotic, a microorganism must fulfill defined criteria. Probiotics must be natural, non-pathogenic components of the intestinal

Table 4: Effects of prebiotics

- Selectively stimulate the growth of bifidobacteria and lactobacilli
- Serve as substrates for production of short-chain fatty acids, CO₂ und H₂
- Increase stool volume
- Increase fecal caloric content
- Reduce the growth of pathogenic bacteria, such as *Clostridia*
- Reduce the penetration of pathogenic bacteria into the mucosal membrane
- Increase calcium absorption

flora. They must remain unchanged during their passage through the colon and they must be able to multiply in the bowel (table 5). The most widely used probiotics include lactobacilli, bifidobacteria, *E. coli* Nissle 1917, streptococci and the yeast *Saccharomyces boulardii*. More recently, combinations of more than one probiotics have enjoyed increasing use. Whether a combination of different microbes is superior to a single probiotic agent cannot be answered definitively at this time.

Under certain conditions probiotics may be successfully used for *preventing recurrence in ulcerative colitis*. The data on *preventing occurrence of inflammation in the pouch (pouchitis)* are also interesting. Several clinical studies have confirmed the efficacy of a probiotic mixture (lactobacilli, bifidobacteria, *Streptococcus thermophilus*) in pouchitis. In these studies, both the development of pouchitis and disease recurrence were reduced in comparison with patients receiving placebo. A new indication for probiotics is lactose intolerance.

Mixtures of pre- and probiotics are called **synbiotics**. It is believed that the two components mutually complement each other in their effects and reinforce them. Currently, there is increased marketing of foods enriched with pre- and/or probiotics. Their role in the treatment or prevention of individual diseases has not yet been conclusively studied.

Table 5: Effects of probiotics

- Restore the integrity of the bowel's mucosal barrier
- Prevent microbial translocation
- Eliminate toxins and eradicate microbial pathogens
- Advantageously modulate the intestinal immune system
- Produce bacteriocins
- Reduce the intestinal pH

6.2 Low-sulfur foods

Sulfur-containing substances in food, if fermented by the metabolism of bacteria in the colon, may contribute to the formation of sulfides. Studies in animals have shown that sulfides may injure the mucosal membrane of the colon and cause changes that resemble those seen in patients with ulcerative colitis. Preliminary studies point to certain eating habits in patients with ulcerative colitis that may indicate a potential correlation with disease activity, namely, a possibly longer duration of the symptom-free interval in patients whose diet contains smaller amounts of sulfur-containing substances. The current state of research, however, does not yet permit a definitive statement on whether a diet low in sulfur may be beneficial in patients with ulcerative colitis.

Out-take: sulfur in foods

Relatively high amounts of sulfur are found in foods with high protein content and in products that have been preserved with sulfate compounds. Foods with high protein content include cheeses, meat and fish and products processed from them. Examples of sulfate-containing additives and preservatives are substances designed with the E-numbers E220 to E228. These substances are found mainly as preservatives in dried fruits and vegetables and in potato products. Sulfur compounds may also be used as preservatives in beer, fruit or sparkling wines (including alcohol-free varieties), mead (honey wine) and liqueurs. Current regulations do not require manufacturers to declare the sulfur content of these beverages.

6.3 Formula supplements

Individual studies have found that patients with Crohn's disease may experience prolonged remission maintenance when they add formula supplements in the form of an orally consumed liquid diet. The currently state of knowledge is inadequate to make a general recommendation in this regard.

6.4 Fish oil and omega-3 fatty acids

Some small studies have found that a diet enriched with omega-3 fatty acids may have a positive effect on remission maintenance at least in Crohn's disease. Omega-3 fatty acids are found especially in oil derived from ocean fish with naturally high fat content caught in cold waters. Omega-3 fatty acids are known to inhibit the release of substances that promote inflammation. The use of fish oil preparations should not be started without first consulting your treating physician since no general therapy recommendations regarding the use of omega-3 fatty acids have yet been made with regard to their efficacy in patients with inflammatory bowel diseases. Better than using fish oil preparations is the regular (two to three servings per week) consumption of fish, such as salmon, mackerel or herring. In addition to omega-3 fatty acids, fish also contain high-quality protein.

7. Are there things I must consider in terms of nutrition if I have been diagnosed with bowel stenosis (narrowing)?

A frequent complication in patients with Crohn's disease is the development of narrowing of the bowel (stenoses). They occur most often near the end of the small bowel (terminal ileum) and frequently necessitate the surgical

removal of segments of the small bowel. The choice of foods depends on the diameter at the site of the stenosis. If the stenosis is an obstacle to the passage of intestinal contents, a diet low in dietary fiber is often recommended. This helps prevent the development of certain painful conditions ranging up to obstruction of the bowel. Patients with stenoses should avoid high-fiber foods like asparagus, fennel, green beans and spinach, foods like cabbage, onions and legumes that contribute to bloating, as well as hard-skinned fruits (e.g. plums, gooseberries etc.), citrus fruits, grapes, nuts, seeds, whole grain products and dietary fiber preparations. Patients with very significant narrowing may require strained foods or formula diets that do not contain dietary fiber.

8. What can I do about fatty stools and diarrhea related to bile acids?

Bile acids are normally absorbed in the terminal ileum and “recycled” (figure 5). Inflammation or surgical removal of this bowel segment, however, has the result that the bile acids reach the colon and are excreted with the stool. The increased excretion of bile acids results in yellow-colored, watery diarrhea (cholegenic diarrhea) with a gradual depletion of the body’s bile acid pool. Bile acids play an important role in the digestion of lipids in that they allow the emulsification of dietary fat in tiny droplets in the small bowel. Persons with a bile acid deficiency experience disturbances of lipid metabolism and fatty stools (steatorrhea).

Patients with fatty stools should replace some of their dietary fat intake with easily digested mid-chain triglycerides (MCT fats). These special fats are sold in health food stores in the form of oil and margarine, and are also

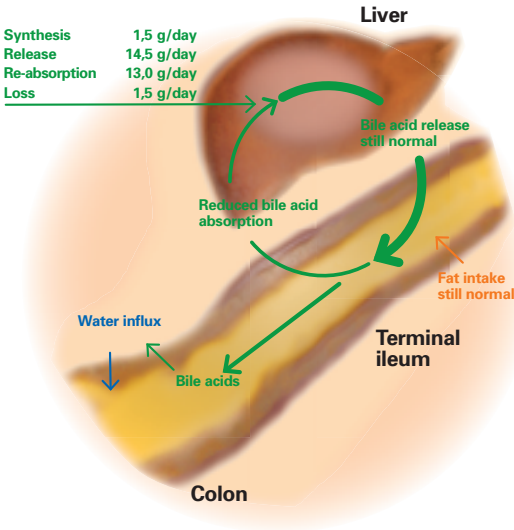


Figure 5: Bile acid circulation

used in the preparation of special foods such as processed cheese and hazelnut-nougat desserts. Patients should also use low-fat foods and food preparation methods that do not add large amounts of extra fat.

9. How does lactose intolerance develop and how should I change my diet?

Patients with inflammatory bowel diseases may develop a temporary intolerance of lactose (milk sugar), especially during an inflammatory flare. The inflammatory process involves the mucosal membrane of the small bowel resulting in the reduced production of lactase, the enzyme responsible for the digestion of lactose. This limits the digestion of lactose and may lead to lactose intolerance. During the remission phase, however, patients with IBD do not experience lactose intolerance at a rate

that is higher than that observed in the general population. If a breath test confirms the diagnosis of lactose intolerance, patients should avoid lactose-containing foods (see table 6) for at least the next three to four weeks. Because most patients tolerate small amounts of lactose, individual testing of tolerance is recommended. Patients with lactose intolerance may still tolerate moderate amounts of foods such as hard and sliced cheese and sour milk products. This is important for supplying the body's calcium requirements and reducing the risk of osteoporosis. It is important that lactose-containing foods be taken in small amounts spread out over the whole day. For example, one slice of hard cheese supplies about a third of the body's recommended daily allowance of calcium. On the other hand, there is an increasing variety of so-called lactose-free or low-lactose

Table 6: Foods containing lactose

- Milk (all fat levels) obtained from mammals, e.g. cow, sheep, goat, mare
- All products made from milk or milk powder, e.g. milk mix beverages, pudding, cocoa, sweets containing milk, dessert creams made with milk, porridge made with milk, beverages with dairy base, milk powder, protein concentrates (e.g. sports diets)
- Condensed milk (all fat levels), cream, dairy coffee creamer, milk powder
- Sour milk products such as sour milk, buttermilk, kefir, yoghurt (including with fruit), curds, fresh cream, sweet and sour cream
- Processed cheese (hard, slice, soft and sour milk cheese contain very low amounts of lactose), cottage cheese
- Milk ice, milk chocolate, nougat, cream bonbons, caramel bonbons, nut-nougat cream, pralines, various candy bars, candy fillings etc.
- Ready-to-eat products with added lactose, such as instant mashed potato powder or cream soups, complete ready-to-eat meals, cream sauces, salad dressings; frozen meat, fish and vegetable products may contain lactose
- Sausages, liverwurst, canned sausage, low-calorie sausages
- Some types of crisp bread, milk biscuits, cakes, cookies, crackers, bread and cake mixes, müsli mixes
- Infant formula
- Butter and margarine (contain small amounts of lactose)
- Some medications, laxatives, artificial sweeteners and bran preparations for digestive enhancement

dairy products available in supermarkets. Calcium may also be supplied in the form of high-calcium mineral waters (at least 150 mg/liter, > 300 mg/liter is better), calcium-enriched fruit juices, high-calcium vegetables such as broccoli, beets, green cabbage, celery and fennel, as well as soy milk fortified with calcium.

10. When is artificial nutrition necessary and what do I need to know?

Because liquid and tube feeding is more effective and is associated with fewer side effects than parenteral nutrition (infusion of solutions containing nutrients), they should be preferred to infusions. Liquid or tube feeding solutions are also called formula diets or astronaut diets. They consist of liquid nutrient blends of varying composition that were initially developed for use during space travel.

Today, we understand liquid and tube-feeding solutions as dietetic preparations blended for patients with specific health problems that supply all essential nutrients. These include so-called fully balanced, usually high molecular-weight diets in which all main nutrients are present in their natural, undigested form (table 7). Products from different manufacturers offer a wide variety of flavors and are available with and without added dietary fiber. Fiber should be avoided by patients during an acute flare and in those in whom stenoses have been diagnosed, since they may “plug” the narrowed bowel segment.

So-called elemental or low molecular weight diets with “pre-digested” and easily digestible nutrients are available. The nutrients contained in these diets are mostly absorbed in the upper segments of the small bowel. These can be used in patients with significant reduction

in nutrient absorption. The more severe the inflammation in bowel segments responsible for absorption, the more restricted is the digestive performance and the more limited the capacity of the bowel to absorb nutrients. In “predigested diets,” the main nutrients, such as proteins, are present, at least in part, in the form of amino acids, which explains their unpleasant taste. More recently, various manufacturers have introduced fat-free solutions for use in patients with significant reduction of fat digestion. For acute flares of Crohn’s disease occurring in children, it was actually shown that exclusive use of formula feeding for six to eight weeks was more effective than therapy with corticosteroids (“cortisone”). For this reason, enteral nutrition using formula diets is always preferred in children. With respect to efficacy, studies found no difference between low and high molecular-weight formulas. In studies with adults, evidence did not show formula nutrition to be superior to “cortisone therapy”, although it was superior to placebo. This means that, even in adults, the exclusive use of a formula diet makes sense and can help reduce the side effects associated with cortisone therapy.

Table 7: Classification of liquid and tube feeding products according to nutrient substrates

High molecular-weight substrates (nutrient-defined diets)
<ul style="list-style-type: none">• Caloric content: 1–2 kcal/ml• With or without dietary fiber• Standard diets: intact protein, long-chain carbohydrates (polysaccharides), compound sugars (oligosaccharides), long-chain fatty acids
Modified diets: e.g. with increased protein content or with mid-chain fatty acids
Low molecular-weight substrates (chemically defined diets)
<ul style="list-style-type: none">• Caloric content: 1 kcal/ml• Without dietary fiber• Oligopeptide diets: partially digested proteins (oligopeptides), compound sugars and simple sugars (monosaccharides), mid-chain fatty acids

In adults, however, it is not so easy to demand the degree of discipline expected in children. For this reason, the long-term exclusive nutrition with formula diets in adults is mostly limited to patients in whom medications have proven ineffective. For better long-term acceptance, the liquid diet can be applied through a nasogastric tube or a temporary percutaneous tube into the stomach. Your treating physician will provide you with complete information about the different available options.

There are no confirmed data regarding the efficacy of special diets or nutrition therapies on disease activity in the acute phase of ulcerative colitis. Nevertheless, artificial nutrition may be essential for assuring adequate supplies of nutrients in patients with severe disease, such as in cases of toxic megacolon.

Therapy with liquid or tube feeding does not necessarily require hospital admission. Enteral liquid diets can be administered by services providing home care. These agencies work together with the manufacturers and care providers. Based on the physician's prescription, they deliver nutritional products and the necessary technical adjuncts, such as pumps and tube systems. They also train family members and other caregivers when this is needed.

In order to prevent unnecessary complications when using liquid or tube feeding, the following precautions should be observed. First, it is important to start slow with the amount of liquid nutrition and increase this gradually. In the first days, it is recommended to start with a small amount (250–500 ml/day) and, if the patient tolerates this, to gradually increase the amount. Liquid diets should also be started slowly and consumed in small swallows. Patients with lactose intolerance should be given liquid diets free of lactose. In cases of stenoses, a liquid diet free of dietary fiber must be chosen. If the liquid diet or tube feeding represents the patient's

complete enteral intake, it must be planned in such a way as to be balanced and cover the patient's total daily requirements. Additional fluid intake is absolutely necessary.

Once opened, cans of liquid nutrition must be refrigerated if they are not immediately used. They must be discarded after 24 hours, even if refrigerated. The liquid should not be consumed in large amounts if ice-cold.

If digestion of lipids is restricted, patients may benefit from a fat-free diet or a diet containing MCT fats, which are more easily digested. A low molecular-weight diet (partially digested proteins and MCT fats) can be considered for patients with extensive and severe inflammation. If patients do experience intolerance reactions, such as increased diarrhea or nausea and vomiting, the first measure is to reduce the amount given and to give the reduced amount over a longer period of time. Switching from a high to a low molecular-weight solution can also be helpful.

In especially severe cases, as in patients with high-grade stenoses, massive fistular systems and symptoms of intestinal obstruction (ileus/subileus symptoms), it may be temporarily necessary to completely avoid any intake through the gastrointestinal tract. Nutrition is then provided by means of infusion therapy, in which all necessary nutrients broken down into the smallest building blocks are administered directly into the circulating blood. With parenteral nutrition, all nutrient substances are dissolved in water and applied through a central venous catheter directly into the blood stream (figure 6). The gastrointestinal tract is allowed to rest, which in most cases results in a rapid resolution of signs of inflammation. Before parenteral nutrition is selected, it is important to always assess the possibility of enteral nutrition therapy. When given for a long time, parenteral nutrition is almost always associated with changes in the mucosal mem-

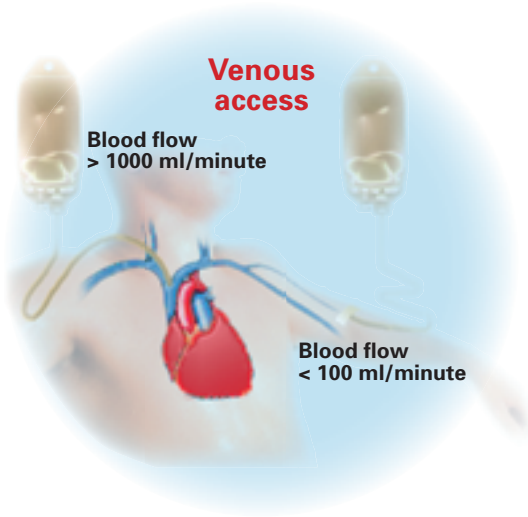


Figure 6: Venous access for parenteral nutrition

brane of the small bowel (atrophy of the villi), which makes the subsequent transition to a normal diet more difficult. Patients should, therefore, whenever possible, continue to take small amounts of liquid diet by mouth or, prior to ending parenteral nutrition, be re-accustomed to enteral nutrition by giving small amounts of liquid diet and/or crackers or white bread. This helps prevent atrophy of the villi and slowly rebuild the intestinal mucosa. Long-term administration of parenteral nutrition can also be done at home. Patients require placement of a long-term central venous catheter. If administered at home, however, parenteral nutrition requires the highest hygienic standards in order to avoid infection of the catheter. In these cases, the help of a home-care service or other healthcare provider agency is indispensable.

Advantages of enteral over parenteral nutrition:

- More natural form of nutrition
- Less expensive
- Associated with fewer risks
- Simpler to advance diet with natural foods, because no atrophy of colonic mucosal folds

11. What must I do after surgery involving the bowel?

There is no uniform diet recommendation for patients who have undergone creation of a stoma or pouch. Depending on the function of the remaining bowel, a patient's individual tolerance for every food and method of preparation must be determined (figure 7). In the build-up to a full diet, patients should add no more than one new food item introduced in small quantities. If possible, foods and your reactions to them should be documented in a journal or diary.

11.1 Special dietary factors to be considered after creation of an ileostomy, jejunostomy or ileoanal pouch

An ileostomy is an artificial outlet for the bowel, which ends in the lower part of the small bowel. With a jejunostomy the bowel outlet is placed in the jejunum, above the final segment of the small bowel (ileum). An ileoanal pouch is created when the lower segment of the small bowel is connected directly with the rectum after surgical removal of the colon. In all of these situations, loss of the colon means loss of this organ's function of thickening the stool.

Under normal conditions, about 1000–1500 ml of water, together with minerals and other nutrients, are absorbed by the colon each day. In addition, removal of the colon

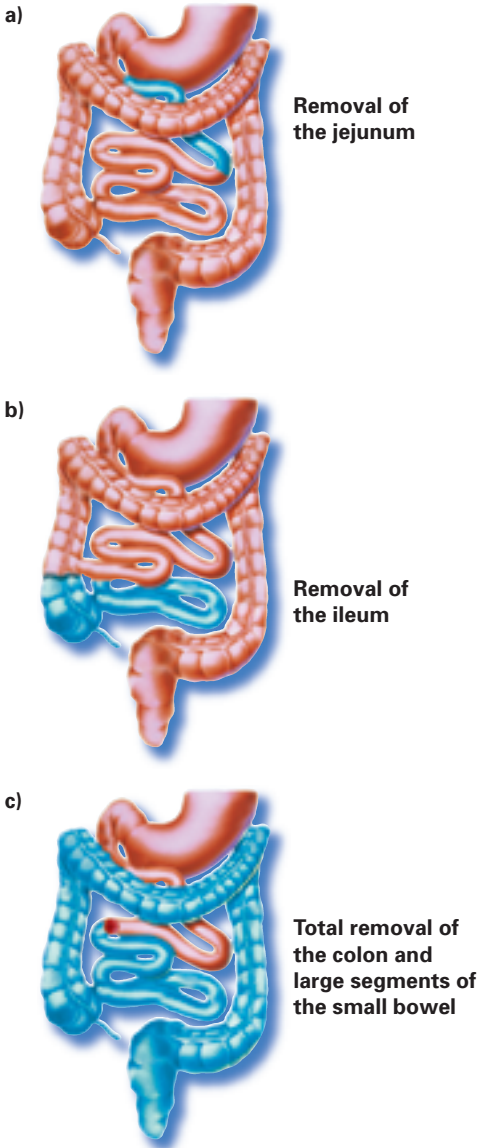


Figure 7: Short-bowel syndrome according to the type of resection. a) Jejunum resection; b) Ileum resection; c) Extensive resection

results in acceleration of the entire bowel transit, reducing the time available for digestion and absorption of nutrients.

Further limitations of function occur when portions of the ileum and/or jejunum are removed. Although the entire small bowel is preserved in cases of ileoanal pouch creation, there may be increased excretion of bile acids, which can worsen the diarrhea. Patients with shortened ileum should receive regular supplementation with vitamin B₁₂ in the form of injection.

The goal of nutrition therapy is, depending on the function of the remaining bowel, to prevent losses of water and electrolytes and also the chemical irritation of the stoma or bowel outlet by substances in foods. Stabilization of stool consistency and frequency takes eight or even 12 weeks after placement of an ileostoma or ileoanal pouch. At this point, patients can expect about three to five liquid to porridge-like stools per day.

The shorter the residual bowel, the lower the probability that the remaining bowel segments will be able to compensate for lost function. Even with extensive resection of the small bowel, however, the absorptive capacity of the remaining bowel slowly improves, such that a stable situation is achieved after about 12 months.

Patients with very watery diarrhea, and during the adaptation phase in general, often benefit from eating “constipating” foods, such as potatoes, rice, oatmeal, bananas or finely grated apples. If needed, bulking foods and fluid-binding preparations such as pectins or other fiber preparations (e.g. psyllium husk) can be used to further thicken the stool. If there is excess elimination of lipids, the dietary recommendations for fatty stools should be observed (see chapter 8).

The body requires about three liters of fluid per day. Well suited are beverages such as tea, non-carbonated mineral water, dilute juices and especially electrolyte drinks.

A daily urine amount of at least one liter per day is

evidence of adequate fluid intake. This should be checked regularly and patients should also pay attention to the color of the urine, which should be light yellow. Patients with short residual bowel (short-bowel syndrome), and particularly immediately after surgical removal of bowel segments, should drink especially **between meals** in order not to overload the bowel. Sodium losses can be compensated by a daily salt intake of 6–9 grams in the form of salted meat or vegetable broths and salted baked wares.

In general, patients are advised to take a diet high in dietary fiber, including a lot of vegetables, fruit and whole grain products. Fiber helps thicken the stool and bind bile acids. The first step is constructing a diet based on the principles of light full diet described in tables 2 and 3. This helps you achieve a balanced diet according to the guidelines of the professional societies. In cases of heavy diarrhea and high ostomy losses, patients should take several (five to six) small meals spread out over the day and also take care to evenly distribute their fluid intake over the day.

Patients who have undergone removal of the colon often find that they are again able to eat certain foods that had triggered symptoms in the acute phase of the disease, so that they have a greater variety of food options. Experience, however, shows that ostomy patients should avoid foods that irritate, damage or block the outlet, including foods with long fibers, shells and hard-to-digest components that may not be sufficiently macerated by chewing. These include asparagus, green beans, celery, fennel, corn (maize), tomato skin, mushrooms, hard-skinned fruits (plums, gooseberries), grape seeds, citrus fruits, popcorn and hard meats.

Despite compliance with nutritional recommendations, patients with extensive bowel resections may experience nutrient losses, especially during the adaptation phase

and in cases of persistent heavy diarrhea and ostomy losses. The supply of minerals and trace elements (potassium, calcium, magnesium, iron, zinc), together with vitamin B₁₂ and the fat-soluble vitamins A, D, E and K may become critical, as can the body's fluid and caloric intake. Replacement of these losses may only be partially possible using oral preparations. In many cases, the addition of injections or even long-term infusion therapy (parenteral nutrition administered at home) may be required for replacement of fluid, energy and nutrient deficits.

11.2 Special dietary factors to be considered after creation of a colostomy

A colostomy is an artificial bowel outlet originating from the colon. Goals of treatment include achieving normal stool consistency and frequency as well as minimizing passage of intestinal gas, the development of odors (tables 8 and 9) and preventing skin irritation at the ostomy site.

At the beginning of oral food intake, the stools are still watery and soft. In this situation, patients can orient themselves on the principles of light full diet (chapter 5.2, tables 2 and 3). After an adaptation phase of about two weeks, most patients with a functioning residual colon achieve normal stool consistency. The foundation of nutrition therapy after advancing the diet and completing the adaptation phase is a schedule of regular meal times with regulated activities and the avoidance of rushed eating. The diet should consist of a variety of foods high in fiber without special restrictions on the choice of foods just as with persons without bowel problems.

Table 8: Effect of food on the production of intestinal gases

Anti-bloating effects	Bloating effects
Caraway/caraway oil/caraway tea	Carbonated beverages/sparkling wine/beer
Black caraway	Caffeinated beverages
Fennel tea	Fresh fruits/pears
Anis tea	Rhubarb
Whortleberries/whortleberry juice	Legumes/cabbage/peppers/onions/garlic/asparagus/beets/mushrooms
Cranberries/cranberry juice	Fresh bread/pumpernickel
Yoghurt	Eggs/egg products/egg noodles/mayonnaise

Table 9: Effects of foods on the development of odorant substances

Anti-odor effects	Pro-odor effects
Parsley	Cabbage/beans/asparagus/mushrooms/onions/garlic/chives
Lettuce	Eggs/egg-based products
Spinach	Meat/meat products, especially smoked meats
Cranberries/cranberry juice	Animal fats
Whortleberries/whortleberry juice	Fish/fish products, especially smoked and fried/crab, lobster
Yoghurt	Cheese Spices

11.3 Special dietary factors in patients with increased oxalic acid excretion

Patients with extensive removal of the small bowel, especially of the ileum (lower end of the small bowel), with preservation of the colon, have an increased risk for developing kidney stones due to the increased excretion of oxalic acid through the kidneys. This increased excretion of oxalic acid results from disturbances of lipid digestion. Under normal conditions, oxalic acid forms insoluble

Table 10: Foods rich in oxalic acid and calcium

Foods rich in oxalic acid – avoid –	Foods rich in calcium – prefer –
<ul style="list-style-type: none">• Rhubarb• Spinach• Beets• Sorrel• Peanuts• Cocoa• Chocolate• Coke beverages• Excessive amounts of tea	<ul style="list-style-type: none">• Pudding• Yoghurt• Cheese• Milk• Buttermilk• Kefir• Dairy products (curds contain small amounts of calcium!)

compounds with calcium from the food and these are excreted with the stool. As a result of bowel resection, the amount of undigested fatty acids increases and these bind with calcium to form so-called calcium soaps. This also means that less oxalic acid is bound in the bowel and more is absorbed into the body. Oxalic acid is excreted through the kidney, where an increased oxalic concentration in the presence of calcium leads to deposit of insoluble salts that accumulate to form calcium oxalate stones.

To help prevent this, foods high in oxalic acid should be avoided and a reduced-fat diet rich in calcium should be started (table 10). If tolerated, each meal should include at least a small amount of milk or dairy products. A more effective measure is the daily intake of calcium (1–2 grams/day). Because the calcium absorption in the bowel is limited, excess oxalic acid is bound in the bowel and excreted.

12. How helpful is dietary fiber?

Fiber is a component of foods of vegetable origin that belongs to the carbohydrates. In the human digestive

tract, these substances are not, or only partially, digested and thus reach the colon unchanged. They are classified as soluble or insoluble depending on the degree to which they can be dissolved in water. The most important sources of dietary fiber include grains, vegetables, potatoes, fruit and seeds. Soluble fiber (e.g. pectin, FOS, glucans) found in large amounts in guar seed flour, oats, barley, plantago and pectin-rich fruits such as apples and pears. Insoluble fiber, including cellulose, hemicellulose and lignin, are found mainly in whole grain products. Bacteria in the colon metabolize fiber to short-chain fatty acids, which serve as nutrients for the colon's mucosal membrane. As such, short-chain fatty acids and the soluble fiber from which they are derived play a direct role in maintaining the health of the colon's mucosal membrane. Various studies have shown that different kinds of soluble fiber may help reduce the recurrence rate in patients with ulcerative colitis and generally act to reduce inflammation.

The actual content of soluble fiber in many natural foods is fairly low. For example, three apples contain only about 3 grams of pectin. Thus, use of preparations made with soluble fiber may be helpful. Concentrates of apple pectin, plantago seed pod (psyllium) and guar seed flour in powder form are currently available.

Besides maintaining the health of the colon's mucosal membrane, dietary fiber has other positive effects:

- Because of its ability to bind water and act as bulking agents, fibers (especially soluble) act to regulate the bowel movements. That means that they are useful both in constipation and diarrhea by acting to thicken loose stools and soften hard stools.
- They bind toxins, preventing their absorption into the body.
- Dietary fiber binds bile acids and promotes their excretion. This affects cholesterol metabolism.

Foods rich in dietary fiber are an essential part of a balanced diet even in patients with inflammatory bowel diseases. Especially in the remission phase, high-fiber foods are normally well-tolerated by IBD patients. A diet high in fiber does not necessarily mean eating foods typically associated with high fiber content, such as coarse whole grain bread, dried fruits, sauerkraut and other types of cabbage. Easily digested, but still high-fiber foods include whole grain toast bread, bananas, cooked fruits and vegetables, mashed potatoes, oatmeal, apple-sauce and bakery items made with finely milled whole grain flour.

Fiber requires water for its bulking action. Adequate fluid intake is therefore crucial. This is especially true when using fiber concentrates. Only during an acute flare or in the presence of stenoses (narrowing of the bowel due to scar tissue formation) should patients avoid foods high in fiber.

13. Are there any ingredients in foods that I should avoid?

Carrageen, a food additive and stabilizer, has been shown in animal experiments to cause intestinal ulcerations, bloody stool and increased permeability of the intestinal mucosal membrane. This has not been shown to occur in humans. Whether there is a connection between carrageen and inflammatory bowel diseases remains controversial.

Carrageen is derived from algae and may be found in alcoholic beverages, cocoa drinks, biscuits, desserts, ice cream, instant products, milkshakes, dessert toppings, salad dressings or frozen bakery items. If present, it must be listed on the label. Because of its controversial role in association with IBD, most manufacturers of formula diets have stopped using this additive.

14. Do sweets, sugar and refined carbohydrates worsen the course of the illness?

Numerous epidemiological studies have examined the question of whether sugar and refined carbohydrates represent a potential triggering factor for Crohn's disease. As early as the 1970's, data from studies showed that patients with inflammatory bowel diseases often consumed large amounts of sugar (beverages, sweets) and refined carbohydrates (bleached flour, corn flakes etc.). The fact that these patients, especially ones suffering from Crohn's disease, did consume large amounts of sugar and refined carbohydrates, however, is most likely a result of these foods being more "easily digested" than whole grain products. Population studies that have investigated changes in the rate of these diseases over the past 50 years did not provide data that confirmed the hypothesis that a change in people's sugar consumption during this period correlated with the increasing number of cases of inflammatory bowel diseases. More recent large studies, however, have identified a connection between the consumption of foods that are high in sugar with the increasing rate of inflammatory bowel diseases, although it is difficult to assess the actual impact of this observation within the context of the general changes in lifestyle that have occurred over the past five decades. Also unclear are the findings of patient studies which investigated the correlation between diets high in refined carbohydrates and low in dietary fiber with the length of remission. The currently available data, therefore, do not permit definitive conclusions regarding the connection between sugar, refined carbohydrates and inflammatory bowel diseases.

At this time, patients with inflammatory bowel diseases are subject to the same recommendation issued for healthy persons. Patients should, however, always consider any individual intolerances and construct their diet

according to the phase of their illness and any specific recommendations in response to complications (stenoses, artificial bowel outlet etc.).

15. Can I drink alcohol?

There is no known correlation between alcohol and the development of inflammatory bowel diseases. There are also no data available regarding the effect of alcohol on the clinical course of IBD. Whether alcoholic beverages cause digestive complaints in relation to the stage of the disease must be tested on an individual basis. Both the amount, type and alcohol content of the respective beverage must be considered. Liquor in particular may irritate the mucosal membrane of the upper digestive tract and patients are generally advised to avoid such beverages.

It is a general principle that regular consumption of alcohol, especially when excessive, can cause serious damage to health. The risk of damage to the liver must always be kept in mind, especially by patients who at the same time are taking medications that are metabolized in the liver.

It is known that alcohol-related liver damage can occur with regular consumption of 10 grams of alcohol per day in women and 20 grams per day in men. Ten grams of alcohol corresponds to about 100 ml of wine or 250 ml of beer.

16. What type of nutrition is essential for my baby?

As has been explained in chapter 2 (“Can the wrong diet trigger IBD?”), there is no confirmed connection between certain nutritional factors and the development of

IBD. Only in the case of breast feeding is there evidence for a reduced risk of developing IBD in breast-fed infants. Especially with regard to minimizing the risk of developing allergies, the general recommendation is to breast feed exclusively for at least four to six months before introducing pap.

17. What changes can I make in my diet to prevent development of osteoporosis?

Patients with inflammatory bowel diseases are at increased risk for loss of bone mass, the associated reduction in bone density and the early occurrence of osteoporosis. Osteoporosis is defined as the reduction in bone mass that exceeds that considered normal for the patient's age and gender. In an advanced stage, osteoporosis is associated with an increased risk for bone fractures and deformations.

Throughout our lives, the osseous tissue of the bone is subject to a continuous process of building and maintenance. This means that the bone is constantly being built up, destroyed and again rebuilt. Up to about 30 years of age, the building processes predominate; as we age, the processes of bone destruction become more and more prominent (figure 8). Thus, humans reach their peak bone mass at about age 30 years. This peak or maximum bone mass depends to a large extent on individual factors, which include a person's genetic background, as well as other factors that are subject to external influence. Important factors include the adequate supply of calcium and vitamin D, as well as the degree of physical activity during childhood, adolescence and early adult life. Accordingly, illnesses such as IBD, especially when they first occur in childhood, can exert a negative effect on early bone metabolism and negatively affect the maximum achievable bone mass.

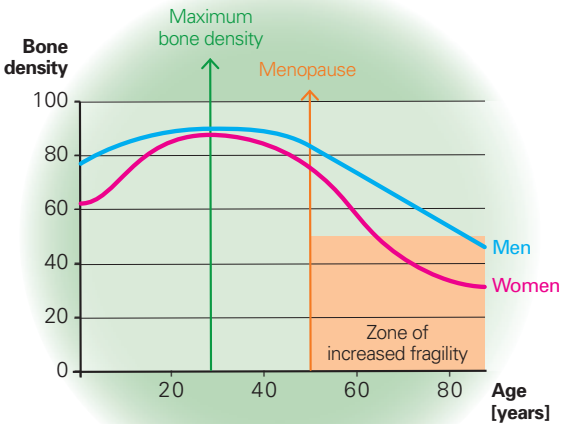


Figure 8: Lifetime changes in bone mass

One of the most important risk factors (table 11) for developing osteoporosis in advancing age is the female menopause, since the resulting deficiency in the female sex hormone estrogen promotes reduction in bone mass and in bone density. Bone mass can be assessed using the so-called DEXA technique, standing for “Dual Energy X-ray Absorptiometry”. With this method, a weak beam of radiation is directed toward the bone: The degree to which the bone absorbs the radiation correlates with the bone’s density.

Patients with IBD must differentiate between osteoporosis risk factors caused by the IBD from those which affect the general population.

General risk factors include, for example, age, female sex (after menopause), an increased occurrence in the family history, occurrence of menopause before age

45 years, low body weight (BMI < 18; for BMI see chapter 5.3), lack of exercise, excessive alcohol consumption and tobacco smoking.

Risk factors for reduced bone mass that are closely associated with IBD are given in table 11. Compared with the normal population, however, it would appear that a majority of IBD patients are not subject to an increased risk of developing osteoporosis. On the one hand, reduced bone density occurring in the context of an acute event – especially in younger individuals – may almost fully regenerate; on the other hand, it appears that the simultaneous occurrence of several risk factors,

Table 11: IBD-associated risk factors for osteoporosis

Risk factor	Explanation
Systemic steroids ("cortisone")	Cortisone-containing preparations promote the destruction of bone mass.
High disease activity and duration	During the active inflammatory phase, mediator (messenger) substances called cytokines are released in the body that have a negative effect on the balance between bone formation and destruction at the cellular level. Patients with frequently recurring flares or disease activity have a higher probability of developing osteoporosis.
Malabsorption, small bowel loss greater than one meter	Inflammation or loss of small bowel segments can result in restricted absorption of nutrients. If the absorption of calcium and/or vitamin D are affected, there is a reduction in bone mass. Lactose intolerance is also a form of malabsorption (see also in chapter 9: Lactose intolerance). The avoidance of calcium-rich dairy products as a therapeutic measure contributes significantly to the increased risk of osteoporosis. This can be minimized by a careful choice of foods.
Insufficient exercise	Maintaining bone mass is dependent to a high degree on physical activity, which may be significantly limited by factors such as long hospital stays. Regular exercise, by stabilizing the muscles, has a positive effect on bone formation.
Crohn's disease	Because Crohn's disease often severely impacts the small bowel, there is a higher risk for reduced absorption of nutrients necessary for the bone metabolism in Crohn's patients than in those with ulcerative colitis.
Low body weight (BMI < 18)	Low body weight is frequently due to inadequate nutritional intake or metabolism. In addition, a low body weight is usually associated with low muscle mass.

including those independent of IBD, is required for osteoporosis to develop. Thus, given appropriate prophylactic measures and suitable therapy, the risk of developing typical symptoms (more frequent fractures, vertebral fractures, skeletal deformations), appears limited to patients with a severe disease course.

Prophylactic measures include regular exercise, the avoidance of additional risk factors such as smoking or excessive alcohol consumptions, and “bone-healthy” nutrition. The basis for a balanced, healthy diet that contains all the nutrients necessary for healthy life in appropriate amounts is contained in the guidelines of the professional societies. We have already discussed the many functions of the nutrients vitamin D and calcium and their extreme importance for healthy bone metabolism. For normal bone formation and maintenance, many other important nutrients are required, including protein, vitamin C, vitamin K, fluoride, zinc and copper.

Because a large proportion of the vitamin D in the human body is formed as a result of sunlight on the skin, the use of vitamin D preparations should be considered in the winter months and in patients confined to bed for long periods. In patients with lactose intolerance (see chapter 9), only about 350 mg of calcium are absorbed daily, compared to the recommended daily allowance of 1000 mg. Here, the diet must be modified to include foods other than dairy products that are high in calcium or to include calcium supplementation in other forms. This has also been covered in chapter 9. Therapy of manifest osteoporosis includes supplementation with calcium and vitamin D preparations, as well as a number of highly effective medications.

Sodium, which is a main component of table salt, promotes calcium excretion in the kidney. For this reason, excessive use of salt and the consumption of highly salt-

ed foods and dishes should be avoided. Calcium excretion is also increased by caffeine: Hence, the excessive consumption of coffee should be avoided, especially in the presence of other risk factors (e.g. inadequate calcium intake, smoking) or in manifest osteoporosis. Coffee may also be consumed with a large portion of milk.

18. What dietary supplements are recommended?

The use of dietary and nutritional supplements, such as vitamin or mineral preparations, or trace elements, can only then be recommended when an actual deficiency of the respective nutrient has been identified or in those cases in which, because the function of certain segments of the gastrointestinal tract has been so severely impacted, patients can be expected to develop inadequate absorption of individual nutrients. This is the case, for example, when patients require surgical removal of the ileum, the last segment of the small bowel. These patients require injections of vitamin B₁₂ at regular intervals. In addition, patients with IBD are especially prone to developing zinc deficiency, which may require the administration of zinc preparations. If zinc supplementation is necessary, patients should take care to always use organic zinc compounds (such as zinc-histidine), because these are more efficiently metabolized by the body than are inorganic zinc compounds. A complete overview of potential nutrient deficiency situations and what can be done about them can be found in section 3: “Nutritional deficiencies in IBD: How do they occur and what can I do?”

19. Are there special recommendations in pregnancy?

In general, patients without disease complications are given the same recommendations for diet and nutrition during pregnancy as are given to healthy women.

If complications occur or in patients in whom nutritional deficiencies can be expected, individual dietary counseling in cooperating with your treating physician is recommended.

20. What must I consider while traveling?

There are no general dietary recommendations when traveling. During the remission phase, traveling is normally unproblematic. Because patients with IBD often experience diarrhea, one should always assure adequate fluid intake. Hence, make sure you have an adequate supply of beverages when traveling by automobile and on hiking or cycling trips. This is especially true when traveling in areas with less developed infrastructures, where you may not always be able to purchase what you need. When traveling further from home, the availability of specific foods, even in countries of Western Europe, may vary. IBD patients should be careful when trying new and unfamiliar foods, since these may not be well tolerated. Problems are especially likely with spicy or greasy foods. When dining, request information on the methods of food preparation.

Because IBD patients, due to the potentially compromised barrier function of the intestinal mucosal membrane, may be more susceptible to bacteria responsible for gastrointestinal infections, every effort should be made to assure that foods eaten are hygienically unobjectionable. In order to avoid an unnecessary exposure to infection, finding out about the hygienic standards of

your proposed destination should be part of vacation planning. Especially in countries with a warm climate and in which Western hygienic standards cannot be reliably expected, you should consider the following points:

- Avoid the consumption of tap water: For oral hygiene and for cooking and washing foods, the use of packaged drinking water is recommended.
- In restaurants, drink only sealed beverages without the addition of ice cubes.
- Eat only freshly peeled fruit that has been washed prior to peeling with heated, packaged drinking water. Do not forget to wash your hands before peeling.
- Eat only freshly boiled vegetables or prepare raw vegetables the same way as fruit.
- Lettuce should also be washed prior to consumption with heated, packaged drinking water.
- The fundamental rule for fruit and vegetables is: peel it, boil it or forget it.
- Eat meat, poultry and fish only well-done since contaminating microorganisms can cause serious gastrointestinal infections. Even “medium” cooked meats should be avoided when abroad.
- Consume only pasteurized, sterilized or boiled milk and dairy products.
- Avoid foods that are prepared and sold at kiosks or street-side snack bars and patronize restaurants that meet hygienic standards. Such information can be obtained in guide books, from your travel agency or from local tourist information outlets.

21. What must I consider when processing and preparing foods?

Immunosuppressants such as azathioprine, methotrexate and TNF- α antagonists weaken the immune system. This is especially true when these drugs are given in

combination. For this reason, IBD patients treated with these drugs should strive for a “low-bacteria” diet. The following principles can help:

- Left-over foods are an ideal growth medium for disease-causing bacteria. Foods should always be stored in a cool and dark place.
- Work surfaces in the kitchen should be washed with hot water in order to prevent colonization by bacteria.
- Perishable foods such as milk, meat, sausage, fish and opened juices should be promptly consumed.
- Raw meat may contain bacteria, including toxoplasma or hepatitis E virus (wild meat). Meat (and fish!) should be carefully washed prior to preparation and thoroughly cooked (core temperature > 70 °C). Exercise particular care with poultry. If possible, cook and eat only in your own home. Meat that is not thoroughly cooked may contain salmonella.
- Do not drink unpasteurized milk from farms. Raw milk products, such as raw milk cheese are also taboo.
- Eat only hard-boiled eggs. Caution with “hidden” eggs in mayonnaise or tiramisù: These foods are frequent sources of food poisoning (salmonella) especially in summer.
- Avoid all moldy foods. Simply cutting off the spoiled surface does not eliminate all the fungus. These foods must be discarded.

Summary

Although diet and nutrition represent important factors in the treatment of inflammatory bowel diseases, there is no specific “Crohn’s or colitis diet”. Although certain dietary habits have been suspected of playing a role in the development of these diseases, there is no scientifically proven evidence. One-size-fits-all nutrition guidelines and dogmatic rules should always be assessed criti-

cally. Diet and nutrition should be tolerable. It must meet your individual needs and be adapted to your disease phase. In such cases, diet and nutrition have a positive effect on how you feel – and on your illness.

In summarizing, the following recommendations can be made:

- It is important to address individual intolerances and other factors, such as complications. Here, speaking with an experienced physician or dietician can be very helpful. Don't forget to complete your nutrition record.
- There is no convincing evidence for the efficacy of a special diet or nutritional therapy in terms of *remission maintenance*.
- During your symptom-free interval, you should take a balanced and adequate diet based on the recommendations of the specialized professional societies, including a high content of dietary fiber. Attention must always be paid to patients' individual nutritional intolerances.
- Nutritional therapy during an *acute inflammatory flare* orients itself on the severity of the inflammation and any associated factors, such as stenoses and reduced ability to digest nutrients. In the absence of specific complications, patients can take a light, full diet.
- In the presence of stenoses or other obstacles to unimpeded bowel passage, a low fiber diet is necessary.
- Patients experiencing fatty stools should replace a portion of dietary lipids with mid-chain triglycerides (MCT lipids). In order to help prevent kidney stones, patients should consider a diet low in oxalic acid and include dairy products and/or calcium at meals. You should discuss these options with your physician.
- Patients with nutritional deficiencies should add formula or liquid supplements in the amount of about 500 ml per day.

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- General recommendations for supplementation with vitamins or trace elements are not beneficial in patients without complications. If, however, nutritional deficiencies are diagnosed, replacement should specifically target nutrients in which patients are deficient. The intake of nutritional supplements should always be discussed with your treating physician.



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