

## **Reversing Nutrition Deficiencies in Celiac Disease Patients**

**By Christen Cupples Cooper, MS, RD**

Celiac disease is an autoimmune disorder characterized by a permanent intolerance to gluten, a protein found in wheat, rye, barley, and other grains typically consumed in the Western diet. Celiac disease causes inflammation of and damage to the small intestine, leading to the malabsorption of iron, folate, calcium, and vitamin D and, the longer it remains untreated, the fat-soluble vitamins (A, D, E, and K), carbohydrates, and fats.<sup>1</sup> This malabsorption can lead to multisystemic conditions such as anemia, osteoporosis, fertility problems, and delayed growth as well as non-Hodgkin's lymphoma, small-bowel malignancy, and other cancers.<sup>2,3</sup> Compounding its health burden, celiac disease often occurs in the presence of other autoimmune diseases such as rheumatoid arthritis, autoimmune liver disease, Addison's disease, autoimmune hepatitis, and cardiomyopathy.<sup>3</sup>

Currently, about 1% of the US population (1 in 133 people) has been diagnosed with celiac disease. However, many healthcare professionals believe the condition is underdiagnosed, and there are many people who have undetected celiac disease. Americans of European descent seem to be the most frequently diagnosed, while blacks, Latinos, and Asian Americans are less than one-half as likely to be diagnosed with the condition. Women are more likely than men to be diagnosed, and older adults are more likely to be diagnosed than children. Nonetheless, both genetics (the inheritance of celiac-specific genes) and environment (duration of gluten exposure) play roles in the development of celiac disease.<sup>3,4</sup>

The only known effective treatment for celiac disease is eliminating dietary gluten.<sup>5</sup> Therefore, dietitians are central to patient care at all stages of the disease—identification and diagnosis, reversing nutrient deficiencies, healing the small intestine and other affected organs, and helping patients adhere to a gluten-free diet—because they can help their patients or clients manage the necessary changes they'll need to make.

This article will discuss the signs and symptoms of celiac disease as well as common celiac disease-related nutrient deficiencies. Dietitians will learn more about the gluten-free diet and become better acquainted with the foods that promote intestinal healing. Dietetic expertise is key to the team care model for treating celiac disease patients.

### **Recognizing Symptoms**

Celiac disease symptoms can vary widely between patients since factors such as age, gender, and disease duration impact disease manifestation. Detection also can be complicated by an absence of outward symptoms. Typically, adult and adolescent sufferers present with chronic diarrhea or constipation; pale, foul-smelling, or fatty stools; abdominal pain; gas; vomiting; weakness; and weight gain or loss. Gluten sensitivity, usually reported as diarrhea or other types of gastrointestinal discomfort after eating gluten-containing foods, is considered to be a subset of gluten intolerance. Celiac disease also is considered a subset of gluten intolerance.

Adults are more likely than children to present with additional symptoms resulting from nutrient deficiencies and diarrhea since the disease has had more time to progress to the proximal and distal sections of the small intestine. As summarized in an article by Mary Niewinski, MS, RD, published in the April 2008 issue of the *Journal of the American Dietetic Association* (now the *Journal of the Academy of Nutrition and Dietetics*), these additional symptoms may include unexplained anemia, folate or zinc deficiency, low bone mineral density, dyspepsia, bone or joint pain, tooth discoloration, oral ulcers, arthritis, fatigue, menstrual irregularities, fertility problems or miscarriage, depression, anxiety, numbness or tingling in the hands and feet, or dermatitis herpetiformis (a chronic itchy, blistering skin rash).

### **Pathogenesis and Diagnosis**

What causes malabsorption in the celiac patient? Unlike in healthy individuals, a celiac patient's intestinal epithelium lacks the tight junctions that create a barrier to foreign bodies. Without this barrier, the intestinal epithelium allows gluten protein fragments to pass into the lamina propria, leading to an autoimmune response. Inflammation at the site destroys the surface epithelial cells, flattening the villi and causing pain, distension, and nutrient malabsorption.<sup>3</sup>

The National Foundation for Celiac Awareness reports that 95% of people with celiac disease aren't aware they have it. This statistic is due in large part to under- and misdiagnosis and not because individuals fail to seek medical care. In fact, many patients experience multiple misdiagnoses before their antibody levels are high enough for the disease to be detected and for their physician to order a biopsy to confirm the presence of the disease.

As indicated by Green and colleagues in 2005 in the *Best Practices of Research on Clinical Gastroenterology*, serological testing for celiac disease isn't 100% sensitive. Even the gold standard test for celiac-specific immunoglobulin A antiendomysial antibodies and antitissue transglutaminase antibodies isn't always accurate. The test often misses subclinical levels of antibodies, and children under the age of 2 don't produce these antibodies. Therefore, for patients whose symptoms continue, despite negative blood tests, celiac disease can't be ruled out without an intestinal biopsy, which involves the risks of an invasive procedure. This means that by the time dietitians see a patient diagnosed with celiac disease, he or she has undergone considerable intestinal damage, suffered multiple symptoms, and experienced painful procedures. Such patients require swift coaching and treatment.

Who's at risk of developing celiac disease? First-degree relatives of someone who has celiac disease, people with other autoimmune disorders such as type 1 diabetes or Hashimoto's thyroiditis, or those with Down syndrome are at increased risk. Green and colleagues reported in the January 2001 issue of *The American Journal of Gastroenterology* that the main genetic marker for celiac disease is class II human leukocyte antigen (HLA-DQ2 and HLA-DQ8), which 97% of celiac patients possess but is also present in many individuals without the condition.

Environment also seems to play a role in celiac disease development. A study by Ivarsson and colleagues, published in the May 2002 issue of *The American Journal of Clinical Nutrition*, suggested that the early introduction of gluten (before the age of 6 months) may heighten the risk of developing celiac disease, but the results weren't statistically significant. A study by D'Amico

and colleagues, published in April 2005 in *Clinical Pediatrics*, found that children who received breast milk exclusively for the first six months exhibited different and delayed celiac disease symptoms (eg, lower severity of diarrhea, growth problems, and gastrointestinal issues) than infants who weren't exclusively breastfed.

### **Coaching for Change**

A celiac disease diagnosis can be shocking, particularly once the patient realizes the difficulties involved in eating a gluten-free diet. Depression and sadness are common reactions, as noted by Hallert and colleagues in an article on living with celiac disease, published in the January 2002 issue of the *Scandinavian Journal of Gastroenterology*. Anger is another common response that can complicate the patient-dietitian relationship. Dealing with the sometimes-limited availability and variety of gluten-free foods; the dearth of gluten-free foods at restaurants; and the price, palatability, and unreliable labeling of gluten-free foods can lead to problems in diet adoption and adherence.<sup>6</sup>

Research shows, however, that quick, strict adoption of the gluten-free diet brings considerable benefits. As reported by Nachman and colleagues in the October 2010 issue of *Digestive and Liver Disease*, although research on quality-of-life satisfaction is limited, recent studies suggest that the patients who are most compliant with the gluten-free diet report the highest quality of life after one year, with the greatest improvements occurring during the first three months. In January 2001, Green and colleagues reported in *The American Journal of Gastroenterology* that, physiologically, adherence to a gluten-free diet can improve symptoms within two weeks and that antibodies may return to normal levels within six to 12 months.

Dietitians can initially assist patients by listening to and understanding patients' emotions and difficulties. They also can communicate the documented short- and long-term benefits of dietary compliance and reinforce the health consequences of noncompliance. They then can focus on helping patients make a smooth transition to the gluten-free diet and monitor them for nutrient deficiencies caused by dietary noncompliance or adherence to a nutrient-poor gluten-free diet. In cases of the latter, dietitians must help clients boost nutrition by suggesting ways to increase the intake of pertinent nutrients.

### **Nutrients for Healing and Health**

Fortunately, adherence to a gluten-free diet that's nutrient dense (but not necessarily calorie dense) can help heal intestinal damage, avoid further gastrointestinal damage, and promote overall good health. Also, a diet that focuses on whole fruits and vegetables, lean protein, and gluten-free whole grains will provide the necessary nutrients for most celiac disease patients. Dietitians can recommend foods that are high in iron, folate, calcium, magnesium, phosphorus, and the fat-soluble vitamins—generally found to be lacking in those with celiac disease. (These nutrients and their best food sources are highlighted in the article "The Gluten-Free Diet: An Update for Health Professionals" by Nixie Raymond, MS, RD; Jenny Heap, MS, RD, LN; and Shelley Case, BSc, RD, published in *Practical Gastroenterology* in September 2006.)

Because gluten-free products aren't subject to the same fortification standards as conventional foods, even a healthful gluten-free diet can contain suboptimal levels of iron, folate, thiamin, riboflavin, niacin, and fiber, which are nutrients commonly supplemented by conventional food

fortification. Dietitians can help patients by recommending fortified or enriched gluten-free brands and foods that are naturally gluten free and fiber rich. Supplements also may be necessary to correct nutrient deficiencies, but they must be gluten free or water miscible.

Dietitians also must be prepared to point out possible nutrient-drug interactions to patients and healthcare professionals on the patient care team. For example, patients taking warfarin should be cautious about taking vitamin K supplements because an increased vitamin K intake can disrupt warfarin's effects. In addition, increased doses of vitamin C can boost the effects of aspirin or nonsteroidal anti-inflammatory drugs.<sup>7</sup>

The following is a discussion of several nutrients in which people with celiac disease may experience a deficiency because of the malabsorption that may result from intestinal damage.

### ***Iron, Folate, and Vitamin B12***

Halfdanarson and colleagues reported in the January 2007 edition of ***Blood*** that iron-deficiency anemia can be detected in 46% of subclinical celiac disease cases, with the higher prevalence in adults rather than children. Vitamin B12 deficiency is reported in untreated celiac disease patients at rates of 8% to 41%. Folate deficiency is common as well since damage often occurs in the jejunum, the center section of the small intestine, where folate is absorbed.

Several foods contain both iron and vitamin B12 and are important for red blood cell formation and the resolution of neurological symptoms, such as peripheral neuropathy and numbness. Heme iron-rich foods such as beef, poultry, fish, and seafood are sources of vitamin B12 and easily absorbed iron. Non-heme iron foods, including beans, tofu, spinach, and molasses, provide less absorbable but important iron. B12 is found in additional sources such as eggs, milk, yogurt, cheese, and fortified grains.

Folate is particularly important for women of childbearing age and can be found in green leafy vegetables such as spinach, enriched rice (naturally gluten free), and in some types of beans and lentils (also rich in iron). Folate also can be found in orange juice, which contains vitamin C that boosts iron absorption. Again, fortified gluten-free grains are a good source of folate as well as other valuable micronutrients.

### ***Calcium and Vitamin D***

Calcium and vitamin D are necessary for healthy bone mineralization and the prevention of osteopenia or osteoporosis in celiac disease patients.

Milk and dairy products, which are normally gluten free, provide a convenient source of both calcium and vitamin D. However, for patients who experience lactose intolerance as a secondary symptom of celiac disease, lactose-free, soy-based, or fermented dairy products may be more favorable. Calcium can be found in whole foods that supply a bevy of important nutrients. Some of these foods include green leafy vegetables such as spinach, collards, and kale; gluten-free grains including quinoa and brown rice; fortified orange juice; calcium-rich soy products; sea vegetables; beans; dried fruits; and blackstrap molasses.

Unlike the bounty of calcium-rich foods available, there are limited food sources of vitamin D. It can be found in fish such as swordfish, salmon, and tuna, fortified milk, and egg yolks. Enriched eggs may be a wise choice for celiac patients because they also contain omega-3 fatty acids, which, according to preliminary research, may help decrease intestinal inflammation in these patients.

For those who have trouble getting enough calcium and vitamin D, supplementation may be a good solution. Adherence to a gluten-free diet with vitamin D supplementation decreased bone turnover activity in a study by Mautalen and colleagues, published in the February 1997 issue of ***The American Journal of Gastroenterology***. The study failed to elucidate, however, which factor—supplementation, dietary adherence to the gluten-free diet, or increased dietary sources of calcium—was most important for this bone-sparing effect. However, vitamin D helps increase calcium absorption, thus eating food sources of each simultaneously can help patients maximize their intake of both micronutrients.

### ***Magnesium and Phosphorus***

The fatigue celiac disease patients experience may be due in part to a magnesium deficiency since this micronutrient aids in the body's energy production and transport. Good magnesium sources include leafy green vegetables, bananas, dried apricots, avocados, peas, beans, soy products, and gluten-free whole grains such as brown rice and millet.

Phosphorus also is important for energy storage and usage, vitamin and mineral usage, and the growth and repair of cells and tissues. Eighty-five percent of the body's phosphorus is found in bones and teeth, and since celiac disease can weaken these, phosphorus must join calcium as a priority nutrient for patients with this condition. Foods supplying phosphorus include meat, poultry, fish, eggs, dairy products, nuts, and legumes as well as whole grains, potatoes, dried fruit, and garlic.

Research on recommended levels of these nutrients for the celiac disease patient is inconclusive as is evidence concerning the value of supplements in addition to dietary sources.

### ***Vitamins E and K***

Fat-soluble vitamins E and K are important for repairing the cellular damage that occurs with celiac disease and can be found in leafy green vegetables. Vitamin E, a disease-fighting antioxidant, also can be found in gluten-free whole grains, wheat germ, vegetable oils, nuts, and seeds, while vitamin K, important for proper blood clotting function, can be found in dairy products, broccoli, and soybean oil.

### **Gluten-Free Grains**

Because gluten-free grains, especially when fortified, can supply valuable nutrients, dietitians can assist patients by recommending the most nutritious gluten-free grains available. Grains are an important source of fiber, which celiac disease patients often underconsume. Many gluten-free grains aren't fiber enriched, but if they're whole grains, they may contain considerable levels of fiber.

The National Foundation for Celiac Awareness lists the following alternatives as gluten free: almond meal flour, amaranth, rice (brown, white, and wild), buckwheat, coconut flour, corn,

cornstarch, guar gum, millet, pea flour, potato flour, potatoes, quinoa, sorghum, soy flour, and teff. According to the Whole Grains Council, amaranth, millet, buckwheat, and wild rice are especially high in fiber.

As highlighted by the previously mentioned article by Raymond and colleagues, quinoa stands out as a gluten-free grain abundant in micronutrients that are important for celiac disease patients (iron, calcium, magnesium, B vitamins, and fiber). Quinoa also is a more complete protein than other gluten-free grains since it's high in lysine.

Oats remain a controversial food in the celiac disease world. Many sources report that when oats are specifically processed to be 100% gluten free, they don't seem to cause intestinal damage in celiac disease patients. However, other studies suggest that many commercial oat products are contaminated with gluten and that many individuals don't seem to respond well to oats. Some celiac disease support organizations have added oats to their list of gluten-free or safe foods, while others have not.

### **Safe Choices**

The safest way for those with celiac disease to live healthfully is to eat naturally gluten-free whole foods. However, since there are gluten-free specialty products available to enhance the gluten-free diet, many celiac patients must carefully study labels for information on gluten content. Currently, shopping for commercial gluten-free products is less difficult than in the past but still risky for those particularly sensitive to gluten because many foods aren't labeled accurately or consistently.

Currently, the Food Allergen Labeling and Consumer Protection Act requires food labels to clearly identify wheat and other common food allergens in the list of ingredients. No federal definition for gluten free exists despite an FDA deadline to establish one by August 2008. The currently proposed US gluten-free definition is as follows:

- A product may be labeled gluten free only if it's at or below the defined threshold of 20 ppm, a number that's generally accepted by experts as safe for those with celiac disease.
- Products that are inherently free of gluten (eg, nongrain products) will be in violation of the law if they're labeled gluten free.
- The labeling will be voluntary.
- The lack of a statement on gluten doesn't mean there's no gluten in the product.

The Gluten Intolerance Group, a US advocacy organization, developed a voluntary labeling program for manufacturers interested in accurately identifying their gluten-free products. The program gives a Gluten-Free Certification mark to products that contain 10 ppm or fewer of gluten. Canada reports that its regulations require gluten-free products to contain zero gluten, but the Canadian government uses 20 ppm as a limit when it tests products for label qualifications. Europe also allows the use of the gluten-free label on foods containing amounts of gluten below 20 ppm since January 1, 2012.

Currently, celiac disease patients encounter obstacles to eating a gluten-free diet when eating out. Not only do few restaurants provide information on gluten, but gluten is found in many sauces, gravies, croutons, fillers, and other products that may be included in basic dishes although not taken into account for labeling purposes. Thus, many groups wish to see better gluten status labeling of all foods.

Rachel Begun, MS, RD, a celiac disease expert who was diagnosed with the condition in 2009, says being a dietitian may make it easy to eat gluten-free foods at home, but she still faces challenges when eating out. Her own knowledge isn't the problem, she explains. It's a lack of awareness about the dietary limitations of celiac disease among food preparers. "After a few bad experiences, I realized the importance of being vigilant about communicating my needs to restaurant management and staff." She also notes that preparing gluten-free meals at home opens up new culinary possibilities that dietitians can communicate to patients. "I eat and cook at home much more often, so my culinary skills have improved tremendously. My eyes have been opened to a whole new world of ingredients that I never cooked with before, including gluten-free whole grains, nut flours, and more."

### **Future Directions**

In recent years, preliminary evidence has been published on the positive effects of various anti-inflammatory foods on the health of celiac disease patients. Because celiac symptoms overlap with those of other gastrointestinal conditions, such as leaky gut syndrome, foods that show promise for alleviating such disorders also may help celiac patients. Some of the nutrients and benefits being studied include probiotics and omega-3 fatty acids for reducing inflammation, alkaline fruits and vegetables for reducing gastrointestinal acidity, and glutamine and zinc for strengthening the gut lining.

As summarized by Schuppan and colleagues in the December 2009 issue of ***Gastroenterology***, scientists hope to explore the genetic modification of grains to alter their gluten contents, the addition of certain lactobacilli to bread to reduce immunotoxicity, oral enzyme therapies, neutralizing gluten antibodies, and intraluminal binding of gluten peptides.

Because food is at the center of not only reversing the past damage to the intestine but also preventing future damage, dietitians can promote health and healing to patients through their support and guidance. As the number of diagnosed patients from diverse populations continues to rise, so does the demand for nutrition professionals with the skills, knowledge, and cultural competence to work with those facing the challenges of this complex, multisystemic disease.

*—Christen Cupples Cooper, MS, RD is the founder of Cooper Nutrition Education & Communications in Pleasantville, New York. She advises schools, businesses, and nonprofit organizations in nutrition and nutrition education services and teaches online courses on school nutrition.*

## Permissible and Forbidden Foods

Permissible Foods	Forbidden Foods
Amaranth	Barley
Arrowroot	Bulgar
Bean flours	Cereal binding
Buckwheat	Couscous
Corn	Dinkel/spelt
Fava beans	Durum
Flax seed	Einkorn
Garbanzo beans	Emmer
Hominy	Farina
Legumes	Farro
Millet	Fu
Nuts, nut flour, and nut meals	Gluten, gluten flour
Oats (uncontaminated)	Graham flour
Rice	Kamut
Sago	Malt (extract, flavoring, syrup, vinegar)
Sorghum flour	Matzoh meal
Soy	Oats (most commercial brands)
Tapioca	Orzo
Teff	Rye
Yucca	Semolina
	Triticale
Gluten-free processed foods (but check labels for potential gluten-containing preservatives and fillers)	Wheat (bran, germ, starch, cracked wheat)
	Non-gluten-free processed foods, including condiments, sauces, and gravies, and foods with gluten-containing preservatives and fillers

Based on information presented in **Celiac Disease Nutrition Guide, Second Edition** by Tricia Thompson, MS, RD



### Nutrients for Health and Healing in the Celiac Patient

<b><i>Nutrients Important for Celiac Disease Patients</i></b>	<b>Vegetables</b>	<b>Fruit</b>	<b>Protein</b>	<b>Dairy</b>	<b>Gluten-Free Grains</b>
Iron	Spinach and other leafy greens		Beef, poultry, fish, seafood (heme)  Beans, tofu (nonheme)		Amaranth, teff, buckwheat, quinoa
Vitamin B <sub>12</sub>			Heme iron sources, eggs	Milk, yogurt, cheese	Fortified gluten-free grains
Folate	Leafy greens	Orange juice	Beans, lentils		Enriched rice
Calcium	Leafy greens, sea vegetables	Fortified orange juice, dried fruit	Calcium-rich soy products, beans, sardines (with bones)	Milk, yogurt, cheese, fortified soymilk	Quinoa, brown rice
Vitamin D	Plant oils (eg, olive)	Fortified orange juice	Swordfish, salmon, tuna, egg yolks	Fortified milk	
Magnesium	Leafy greens, peas	Bananas, dried apricots, avocados	Beans, soy products		Brown rice, millet
Phosphorus	Whole potatoes, garlic	Dried fruit	Beef, poultry, fish, eggs, nuts, legumes	Milk, yogurt	Gluten-free whole grains
Vitamin E	Leafy greens, vegetable oils	Kiwi, mango	Nuts, seeds		Gluten-free whole grains, wheat germ
Vitamin K	Leafy greens, broccoli,			Milk, yogurt	

	soybean oil				
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— Author compiled this table from multiple sources

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## Examination

### 1. Which of the following best describes the pathophysiology of celiac disease?

- A. Gluten remains in the intestinal lumen for a prolonged period, causing diarrhea and vomiting.
- B. Gluten ferments in the intestine, causing bloating.
- C. Gluten fragments enter the intestinal epithelium due to an absence of tight junctions, causing an immune reaction.
- D. Gluten is malabsorbed in celiac patients because they have a genetic tendency to be born without intestinal villi.

### 2. Which cluster of symptoms is most likely to suggest celiac disease?

- A. Diarrhea, bloating, and fatigue
- B. Coughing, vomiting, and fatigue
- C. Fat-soluble vitamin deficiencies, constipation, and depression
- D. A and C

### 3. Which micronutrients are most likely to be deficient in individuals with potential celiac disease?

- A. Iron, calcium, and vitamin D
- B. Vitamin C, vitamin A, and phosphorus
- C. Magnesium and sodium
- D. All of the above

### 4. Which foods are the richest in the nutrients most often found to be deficient in celiac patients?

- A. Gluten-free energy drinks and supplements
- B. Red, yellow, and orange vegetables
- C. Leafy greens and gluten-free whole grains
- D. A and B

### 5. What kind of factors cause celiac disease?

- A. Environmental
- B. Genetic
- C. Environmental and genetic
- D. Unknown

### 6. Which of the following is true?

- A. The majority of patients who adhere to a gluten-free diet for three to six months can resolve their symptoms and return to a diet with no restrictions.
- B. Celiac patients must adhere to a gluten-free diet for the course of their lives, whether or not symptoms resolve.
- C. Celiac patients must follow a gluten-free diet for one to two years or until histological damage heals.
- D. Celiac patients must follow a gluten-free diet. Once symptoms resolve, they can eat small, infrequent gluten-containing meals and snacks.

**7. Which of the following are normally gluten free?**

- A. Amaranth, corn, and yucca
- B. Hominy, legumes, and teff
- C. All of the above
- D. None of the above

**8. Which statement describes the current state of gluten-free labels in the United States?**

- A. The USDA is overdue for establishing a consistent definition of gluten-free foods, and patients should avoid products not clearly labeled.
- B. The USDA recently established a definition of gluten free as any product containing less than 20 ppm of gluten.
- C. The United States currently follows the Canadian threshold for gluten content, which is officially 0 ppm, but products testing below 20 ppm can be considered gluten free.
- D. Since 2012, the United States has followed the European standard of 20 ppm for products labeled gluten free.

**9. Which statement is true regarding gluten-free foods in restaurants?**

- A. Reputable restaurants have committed to labeling their dishes as gluten free when they contain 0 ppm of gluten.
- B. US law prohibits restaurants from advertising gluten-free foods, since most foods have not been tested.
- C. Patients should be aware that foods that would normally be gluten-free may contain ingredients, condiments, sauces, or additives that contain gluten.
- D. Restaurants that display a gluten-free seal must undergo regular inspection to keep their certification.

**10. Which of the following describe(s) current research regarding celiac disease?**

- A. Scientists are exploring oral enzyme therapies and genetic modifications to grains that would enable celiac patients to eat gluten-containing foods.
- B. Scientists are conducting trials of intestinal surgeries that would alter the intestinal epithelium to allow for gluten ingestion.
- C. Scientists are exploring anti-inflammatory and other therapeutic effects of nutrients such as omega-3 fatty acids, glutamine, and zinc.
- D. A and C