


## Episode 132 – Celiac Disease and Oral Health May 9, 2025

### Introduction

Celiac disease is a chronic autoimmune disease, caused by ingesting gluten proteins from wheat, rye, and barley, in genetically predisposed individuals. In celiac disease, the immune system[1] responds abnormally to gluten proteins, leading to inflammation and damage to the lining of the small intestine and reduced absorption of nutrients. Other names for celiac disease include gluten enteropathy, gluten-sensitive enteropathy, celiac sprue, and nontropical sprue. [1] [2] [3]

The exact cause of celiac disease is not fully understood. Factors such as infant feeding practices (e.g., timing of gluten introduction into the diet), gastrointestinal infections, and gut bacteria may play a role. However, these have not been proven. Celiac disease sometimes becomes active following surgery, viral infection, pregnancy, childbirth, or severe emotional stress. [4] [5] [6]

Symptoms of celiac disease may occur in the digestive system, including the oral cavity, or other parts of the body. Individuals with celiac disease have an increased risk of developing health issues, including osteoporosis,[2] lymphoma, type I diabetes,[3] and reproductive problems. In children, celiac disease can lead to growth failure and delayed puberty. A life-long gluten-free diet is the only way to avoid the symptoms and complications of celiac disease. Ingesting as little as 50 mg of gluten (1/60 of a slice of bread) may damage the intestine. [5] [7] [8] [9]

### Prevalence

The global prevalence of celiac disease in the general population is estimated to be 1%. Based on serology testing, the estimated global prevalence is 1.4% and 0.7% for biopsy-confirmed cases. The disease is more prevalent among females (0.6%) than males (0.4%), and children (0.9%) are more affected than adults (0.5%). The disease affects approximately 7.5% of first-degree relatives (parents, siblings, children) of individuals with celiac disease. Onset is generally in childhood but may occur later. [10] [11] [12]

### Etiology

The cause of celiac disease is multifactorial, involving a combination of genetic, environmental, and immune factors. When individuals with celiac disease ingest foods

[1] Refer to Episodes 44 and 45 for additional information on the immune system.
[2] Refer to Episodes 41 and 42 for discussion on osteoporosis and oral health.
[3] Refer to Episodes 91, 93, and 94 for additional information on diabetes.

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containing gluten, it triggers an immunologic-mediated inflammatory response, releasing inflammatory cells and antibodies. The inflammation causes atrophy of the villi (small, finger-like projections lining the small intestine that absorb nutrients), resulting in maldigestion, malabsorption of proteins, fats, carbohydrates, vitamins, and minerals, and in turn, malnutrition. Celiac disease can develop at any age after an individual starts eating foods containing gluten. [13] [14] [15]

Without a strict, lifelong gluten-free diet, inflammation resulting from immune system overactivity may cause a wide variety of signs and symptoms involving multiple areas of the body and produce long-term complications. [14]

**Pathogenesis**

Celiac disease is characterized by damage to the small intestine mucosa, including villous atrophy, crypt hyperplasia, and increased lymphocyte infiltration of the intestinal epithelium (i.e., intraepithelial lymphocytosis). [16] [17]

Villous atrophy is the shrinking and flattening of the intestinal villi, which reduces the surface area available for nutrient absorption. Villi are the small projections lining the small intestine that facilitate nutrient absorption. Crypts are the grooves between the villi. Crypt hyperplasia is when the grooves become elongated or deeper than normal. Crypt hyperplasia occurs as a compensatory response to villous atrophy, leading to an increase in the depth and number of crypts at the base of the villi.

Villous atrophy and crypt hyperplasia decreases the villus-to-crypt ratio. In health, the typical villus-to-crypt ratio is 3:1. In untreated celiac disease, the villus-to-crypt ratio is often less than 2:1 and can be as low as 1:1 or even lower in severe cases.

Intraepithelial lymphocytosis is the inflammatory response to gluten, as lymphocytes (white blood cells) infiltrate the epithelial layer and lamina propria, the thin layer of loose connective tissue below the epithelium. The epithelium and lamina propria form the mucosa of the intestine. [18] [19]

Key elements in the development of celiac disease are genetics (i.e., human leukocyte antigen [HLA]-DQ2 and HLA-DQ8 genotypes), environmental factors (i.e., gluten intake), and autoantigen to tissue transglutaminase (tTG). In addition to genetic susceptibility and gluten exposure, increased intestinal permeability and an imbalanced gut microbiome appear to be components of celiac disease autoimmunity. [11] [20]

**Gluten**

Gluten refers to a group of related proteins known as prolamins and glutenins found in wheat, rye, barley, and triticale (a cross between wheat and rye). The prolamins found in wheat (gliadins), rye (secalins), and barley (hordeins) are of most concern to individuals with celiac disease. Gluten is harmful to anyone with a gluten-related disorder, including celiac disease, wheat allergy, non-celiac gluten sensitivity, dermatitis herpetiformis, and gluten ataxia. [1] [2]

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**Wheat allergy**
A wheat allergy occurs when the immune system reacts abnormally to wheat proteins. The symptoms are related to an immunoglobin E (IgE)-mediated immune response, which can occur within minutes to hours after consuming wheat. This reaction can affect several organ systems, including the skin, respiratory, gastrointestinal, and cardiovascular.[4] Wheat allergy can lead to anaphylaxis, a life-threatening reaction.

Wheat proteins that can trigger an allergic reaction include gluten proteins (i.e. gliadins and glutenins) and other proteins such as albumins and globulins. The only treatment for wheat allergy is to strictly maintain a wheat-free diet. However, rye and barley can be safely consumed. [1] [2]

**Celiac disease versus wheat allergy**
Celiac disease and wheat allergy are two different conditions. In individuals with celiac disease, consuming food that contains gluten causes immune-mediated damage to the lining of the small intestine. This damage interferes with the body's ability to absorb nutrients, potentially leading to anemia, fatigue, chronic diarrhea, abdominal cramping, weight loss, and eventually malnutrition. A wheat allergy occurs when a individual's immune system reacts abnormally to wheat proteins and can be life-threatening. Anyone unsure whether they have celiac disease or a wheat allergy should consult a medical provider (e.g., physician, nurse practitioner, allergist) for evaluation and guidance. [21]

**Non-celiac gluten sensitivity**
Non-celiac gluten sensitivity, also known as gluten intolerance, refers to symptoms caused by ingesting gluten proteins or other wheat-related components, occurring in individuals who do not have celiac disease or wheat allergy. Intestinal biopsies show normal villi with serologic markers excluding celiac disease and wheat allergy.

Symptoms are similar to celiac disease and typically resolve by eliminating wheat and other gluten sources. Symptoms may include abdominal pain, bloating, diarrhea, and constipation, mimicking irritable bowel syndrome. Other symptoms include nausea, acid reflux, and aphthous stomatitis (i.e., aphthous ulcers). Individuals may have non-intestinal symptoms, such as feeling unwell, fatigue, headaches, foggy mind, numbness, joint or muscle pain, and skin dermatitis. Individuals may experience one or more of these symptoms.

There are currently no biomarkers for this disorder. The clinical symptoms of non-celiac gluten sensitivity and celiac disease overlap, making it difficult to distinguish the two disorders based on symptoms alone. Consequently, non-celiac gluten sensitivity is diagnosed by excluding celiac disease. [2] [12] [22] [23] [24]

**Dermatitis herpetiformis**
Dermatitis herpetiformis, or celiac disease of the skin, is a chronic autoimmune disorder characterized by an intensely itchy, blistering rash. The disorder is triggered by gluten

[4] Refer to Episodes 79, 80, and 81 for additional information on cardiovascular diseases.

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ingestion and is strongly associated with celiac disease since most individuals with dermatitis herpetiformis also have celiac disease. However, in most cases, the celiac disease is asymptomatic.

Dermatitis herpetiformis develops in 10-15% of individuals with celiac disease. Onset is most frequently in the second to fourth decade of life. It is more common in males and is rare in children.

Herpetiformis refers to the appearance of the lesions that resemble herpes lesions (small fluid filled blisters), although the condition is not caused by herpesvirus. The extremely itchy bumps or blisters appear symmetrically, often affecting the forearms near the elbows, knees, lower back, buttocks, and hairline. Oral lesions may develop but are usually asymptomatic. Symptoms can fluctuate. Dermatitis herpetiformis is often misdiagnosed as eczema. Diagnosis is confirmed through skin biopsy. Treatment of the condition includes oral dapsone medication (Avlosulfon) and a gluten-free diet. [2] [25] [26] [27] [28] [29] [30]

**Gluten ataxia**

Gluten ataxia is an autoimmune disorder where gluten ingestion damages the cerebellum, the part of the brain that controls gait and muscle coordination. Fine control of voluntary movements is compromised, leading to unsteadiness and incoordination. It is associated with positive antibody blood tests with or without small intestinal inflammation. Some individuals with gluten ataxia also have celiac disease. Treatment for gluten ataxia is a gluten-free diet. [2] [31] [32]

**Risk factors for celiac disease**

Celiac disease almost always occurs in individuals who have one of two groups of the normal gene variants HLA-DQ2 and HLA-DQ8. Individuals who do not have these gene variants are very unlikely to develop celiac disease. However, not all individuals carrying these variants will develop the disease. These variants are found in 30% of the general population, and only 3% of individuals with the gene variants develop celiac disease. Demonstrating that other genetic and environmental factors may be implicated in celiac disease development. [14] [28] [33]

Celiac disease occurs with increased frequency in individuals who have:

- First or second-degree family members with celiac disease or dermatitis herpetiformis
- Type 1 diabetes[5]
- Autoimmune thyroid disease[6]
- Sjögren syndrome[7]

[5] The estimated prevalence of celiac disease in people with type 1 diabetes is 6%. Most people with both conditions have asymptomatic celiac disease, or symptoms that may be confused for diabetes. Screening for celiac disease is recommended after type 1 diabetes has been diagnosed. [84]

[6] Types of autoimmune thyroid diseases include Hashimoto thyroiditis and Graves' disease. [80]

[7] Sjögren syndrome is an autoimmune disorder affecting exocrine glands, primarily salivary and lacrimal glands, causing dry mouth and eyes. The prevalence of celiac disease in individuals with Sjögren syndrome may be as high as 15% and often presents as asymptomatic celiac disease. Individuals with

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- Selective IgA deficiency[8]
- Down syndrome
- Williams syndrome[9]
- Turner syndrome[10]
- Microscopic colitis[11]
- Addison's disease[12] [2] [4] [12] [13] [34]

## Symptoms

The symptoms of celiac disease can vary greatly in extent and severity depending on how much of the small intestine is affected. There are more than 200 known celiac disease symptoms, which may occur in the digestive or other body systems, making diagnosis difficult. Some individuals are asymptomatic or only have signs of nutritional deficiency (e.g., osteoporosis from calcium malabsorption, anemia from iron or folate deficiency).[13] Others have significant gastrointestinal symptoms. Symptoms may differ between children and adults. Some individuals develop celiac disease symptoms as children after the introduction of cereals. Others do not develop symptoms until adulthood. However, anyone with celiac disease is at risk for long-term complications, whether or not they display symptoms.

**Symptoms in adults*** [1] [4] [12] [13] [14] [15] [33] [35]

| | | |
|---|---|---|
| • Diarrhea<br>• Steatorrhea (foul-smelling, pale, bulky, greasy stools)<br>• Weight loss<br>• Bloating and gas<br>• Abdominal pain<br>• Nausea and vomiting<br>• Constipation<br>• Loss of appetite | • Fatigue<br>• Anemia (due to iron or folate deficiency from malabsorption)<br>• Dermatitis herpetiformis<br>• Joint or bone pain<br>• Missed periods<br>• Hyposplenism (reduced spleen function) | • Headaches or migraines<br>• Depression, anxiety<br>• Cognitive impairment<br>• Peripheral neuropathy (numbness, tingling in feet, hands)<br>• Balance problems<br>• Seizures<br>• Elevated liver enzymes |

*Nonexhaustive list

Sjögren syndrome may wish to screen for celiac disease, as following a gluten-free diet may help alleviate symptoms when both conditions are present. [34]
Refer to Episode 107 for discussion on Sjögren syndrome.

[8] Selective IgA deficiency is a primary immunodeficiency characterized by an undetectable level of immunoglobulin A (IgA) in the blood and secretions but no other immunoglobulin deficiencies. [79] [85]

[9] Williams syndrome is a rare genetic disorder affecting multiple parts of the body, leading to distinct facial features, mild intellectual disability, and cardiovascular issues. [86]

[10] Turner syndrome is a condition in which a female is partially or completely missing an X chromosome, which can cause infertility, cardiovascular problems, and altered appearance. [87]

[11] Microscopic colitis is a chronic inflammatory bowel disease in which abnormal immune reactions cause inflammation on the inner lining of the large intestine. The inflammation can only be seen by examining a biopsy of the tissue under a microscope. [81] [82]

[12] Addison's disease, also known as primary adrenal insufficiency, is characterized by inadequate production of the steroid hormones cortisol and aldosterone by the adrenals glands, symptoms include fatigue, nausea, vomiting, abdominal pain, and skin pigmentation. [83]

[13] Celiac disease should be considered in individuals with iron deficiency anemia, especially when there is no evident cause for blood loss and poor response to oral iron supplements. [30]

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**Symptoms in infants and children*** [1] [4] [12] [13] [14] [15] [33] [35]

| | | |
|---|---|---|
| • Nausea and vomiting<br>• Chronic diarrhea<br>• Abdominal distention and pain, gas<br>• Constipation<br>• Steatorrhea<br>• Weight loss<br>• Failure to thrive | • Fatigue<br>• Iron-deficiency anemia<br>• Irritability<br>• Growth impairment (e.g., short stature)<br>• Edema due to low blood protein levels causing fluid retention | • Delayed puberty<br>• Anxiety and depression<br>• Attention-deficit/hyperactivity disorder (ADHD) and learning disabilities<br>• Headaches<br>• Lack of muscle coordination<br>• Seizures |

*Nonexhaustive list

### Oral manifestations

Oral manifestations of celiac disease can occur in children and adults and precede gastrointestinal symptoms. Oral manifestations may include:

- Atrophic glossitis
- Angular cheilitis
- Geographic tongue
- Recurrent aphthous stomatitis
- Dry mouth
- Dental enamel defects
- Delayed tooth eruption and maturity
- Oropharyngeal squamous cell carcinoma[14] [12] [13] [16] [33] [36]

Atrophic glossitis, angular cheilitis, geographic tongue, and delayed tooth eruption may occur due to prolonged malabsorption or malnutrition. The most frequently observed oral manifestations in the pediatric population are recurrent aphthous ulcers and dental enamel defects. Soft tissue manifestations of celiac disease, such as recurrent aphthous ulcers, can be expected to improve after implementing a gluten-free diet. [37] [38] [39]

### Atrophic glossitis

In atrophic glossitis the tongue appears smooth, shiny, and red. The smooth appearance is from filiform papillae atrophy. Some individuals with celiac disease report burning sensation and difficulties with chewing, swallowing, or speaking. Atrophic glossitis is often linked to an underlying nutritional deficiency of iron, folic acid, vitamin B12, riboflavin, or niacin. Atrophic glossitis caused by nutritional deficiency often causes a painful sensation in the tongue. [38] [40] [41]

### Angular cheilitis

Angular cheilitis, also know as angular stomatitis, has been reported among individuals with celiac disease. The condition is characterized by diffuse redness with erosive, fissured, ulcerated, or crusted surfaces in the corners of the mouth. Angular cheilitis may manifest as a result of prolonged malabsorption or malnutrition, particularly vitamin B, zinc, or iron deficiencies. Antifungal treatment may be necessary in cases of secondary infection with candidiasis. [38] [40] [42]

[14] Refer to Episodes 7, 76, 77, and 78 for discussion on oral and oropharyngeal cancers.

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**Geographic tongue**
Geographic tongue or benign migratory glossitis is a chronic, inflammatory and immuno-mediated oral lesion with an unknown etiology. Atrophy of the filiform papillae leaves a red area delineated by a slightly elevated white, yellow, or grey peripheral border, creating an irregular pattern on the tongue. Regions of atrophy spontaneously resolve and migrate. It often affects only a portion of the tongue, primarily the tip. Geographic tongue may occur secondarily to an iron, folic acid, or vitamin B12 deficiency, resulting from intestinal malabsorption. [38] [40] [41]

**Recurrent aphthous stomatitis**
Recurrent aphthous stomatitis, also known as recurrent aphthous ulcers, is a chronic oral mucosa inflammatory disorder with an uncertain etiology. Aphthous ulcers are painful oval or round yellow-grey lesions with well-defined margins surrounded by a red halo, ranging in size from 1 mm to greater than 1 cm. Aphthous ulcers most commonly affect the labial mucosa and lateral borders of the tongue and usually occur in nonkeratinized oral mucosa. The pain and discomfort can significantly impact eating, swallowing, speech, oral self-care,[15] quality of life, and well-being.

Recurrent aphthous ulcers are associated with positive family history, local trauma, stress, immune changes, hormonal imbalance, food hypersensitivity, and nutritional deficiencies. [40]

Recurrent aphthous ulcers are a risk indicator for celiac disease, as they have been found more frequent in individuals with asymptomatic celiac disease. Gastrointestinal conditions such as Crohn's disease and ulcerative colitis are also associated with oral aphthous ulcers. [38] [43] [44] [45]

**Dental enamel defects**
Dental enamel defects include pitting, grooving, discolouration, such as white, yellow, or brown spots, poor formed or missing enamel, and mottled or translucent-looking teeth. Enamel defects in individuals with celiac disease range from 50-94%. The distribution of these defects mainly affects the permanent first molars, incisors, and primary molars symmetrically across all quadrants.

Grade I defects (according to Aine's classification) are more common, although higher grades have been reported. Aine's classification categorizes the severity of enamel defects, typically resulting from systemic diseases such as celiac disease, into grades. grade 0 indicates no defects, while grade IV signifies severe structural tooth defects. Dental enamel defects are more prevalent in children with celiac disease, compared with adults, likely because tooth development is completed before celiac disease onset or the affected teeth have been extracted or cosmetically treated.

Enamel defects may result from malabsorption of nutrients such as calcium and vitamin D due to small intestine damage or an autoimmune response triggered by gluten

[15] Refer to Episode 89 for additional information on oral self-care.

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consumption. Severe enamel defects may increase the risk of tooth sensitivity, esthetic issues, and dental caries.

Differential diagnoses of dental enamel defects include fluorosis, amelogenesis imperfecta, early childhood illness, localized trauma or infection, maternal or childhood tetracycline use. [39] [46] [47] [48]

**Classification of enamel defects** [22] [46] [49]

| | |
|---|---|
| Grade 0 | • No defects. |
| Grade I | • Defects in enamel colour ranging from cream, yellow, or brown opacities. |
| Grade II | • Slight structural defects, rough enamel surface, horizontal grooves, and shallow pits. |
| Grade III | • Rough surface, evident structural defects, deep horizontal grooves, and large vertical pits. |
| Grade IV | • Severe defects in tooth shape and structure. Areas of missing enamel, leading to increased sensitivity, higher risk of caries, and esthetic concerns. |

**Delayed tooth eruption and maturation**
Prolonged malnutrition can impact the eruption and maturation of teeth. Children with celiac disease often experience weight loss and slower growth rates compared to children without the disorder, which may lead to delay in tooth development. Similar to failure to thrive, delayed tooth eruption may indicate malnutrition and requires prompt referral to investigate potential gluten intolerance. [40]

**Dental caries**[16]
Dry mouth and severe enamel defects are risk factors for dental caries. However, the impact of celiac disease on dental caries risk is unclear as studies show mixed results. A systematic review and meta-analysis by Albuquerque et al. (2024) found no significant differences in the prevalence of dental caries in the primary or permanent dentition of children and adolescents with celiac disease and individuals without celiac disease. [39] [50]

**Oral health quality of life**
Oral manifestations of celiac disease in children and adolescents are associated with poorer quality of life related to oral health (OHRQoL)), underscoring the importance of

[16] Refer to Episodes 86 and 87 for additional information on dental caries.

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identifying such manifestations early to improve the management and quality of life in this population. [51] [52]

**Complications**
Untreated celiac disease can lead to:

- Malnutrition, which can cause anemia and weight loss. In children, malnutrition can cause slow growth and short stature.
- Bone issues from vitamin D and calcium deficiencies can lead to osteomalacia (bone softening), osteopenia (low bone density), or osteoporosis (decrease in bone mass and density).
- Reproductive problems, such as infertility in females and males, repeated miscarriage and missed menstrual periods.
- Cancer, such as intestinal lymphoma, carcinoma of the esophagus or oropharynx, and small bowel adenocarcinoma. Intestinal lymphoma should be investigated in individuals who have been doing well on a gluten-free diet and once again develop celiac disease symptoms.
- Nervous system problems, such as seizures and peripheral neuropathy.
- Liver damage, which may lead to cirrhosis or liver failure.
- Food and lactose intolerance. [3] [4] [12] [14] [28] [34] [53]

**Autoimmune disorders**
Celiac disease is an autoimmune disorder that increases the risk of developing additional autoimmune disorders, especially if diagnosed later in life. The most common associated disorders are autoimmune thyroid disease and type 1 diabetes. Conversely, people with an autoimmune disorder are at a higher risk of developing celiac disease. Approximately 2-5% of people with thyroid disease and 5-8% of those with type 1 diabetes develop celiac disease, which can affect both children and adults. [30] [34]

Celiac disease occurs in 4-9% of children with type 1 diabetes. However, 60-70% of these children are asymptomatic. Children with type 1 diabetes are at increased risk for celiac disease during the first 10 years of developing diabetes. [54]

Screening individuals with autoimmune diseases for celiac disease and monitoring those with celiac disease for another autoimmune disorder is essential. A strict gluten-free diet by individuals with celiac disease may reduce the risk of developing another autoimmune disorder. However, it does not eliminate the risk. [30] [34]

**Autoimmune disorder development** [34]

| Age of celiac disease diagnosis | Chance of developing another autoimmune disorder |
|---|---|
| 2-4 years | 10.5% |
| 4-12 years | 16.7% |
| 12-20 years | 27% |
| Over 20 years | 34% |

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## Diagnosis

Celiac disease is diagnosed through a combination of:

- Serology testing
- Genetic testing
- Small-bowel biopsy
- Tests for nutrient deficiencies
- Recovery from celiac disease symptoms while following a gluten-free diet

## Serology testing

Serology testing involves a simple blood test. Elevated levels of specific antibody proteins indicate an immune reaction to gluten. Types of serology tests include:

- Tissue transglutaminase IgA antibody (tTG-IgA), which is the most common initial test, with a sensitivity rate of over 95% for detecting celiac disease.
- IgA endomysial antibody (EMA) has a specificity of almost 100%, making it the most specific test for celiac disease, although it is not as sensitive as the tTG-IgA test. About 5-10% of individuals with celiac disease do not have a positive EMA test.
- Total serum IgA is used to test for IgA deficiency, a condition associated with celiac disease. Approximately 3-5% of individuals with celiac disease have an IgA deficiency, which can cause a false negative tTG-IgA or EMA result. IgA deficiency may indicate other diseases that may cause villus atrophy, such as giardiasis and small-bowel bacterial overgrowth.
- Deamidated gliadin peptide (DGP) IgG antibody is used to further screen for celiac disease in individuals with IgA deficiency or who test negative for tTg or EMA antibodies. [28] [55] [56] [57]

## Genetic testing

Genetic testing for celiac disease involves a blood test or cheek swab to test for HLA-DQ2 and HLA-DQ8. Most individuals with celiac disease carry one of these genes, which appears to increase the risk of an inappropriate immune response to gliadin. Having these genes does not mean an individual has celiac disease. Conversely, celiac disease is very unlikely if these genes are not present. Genetic testing can be used to rule out celiac disease. [56]

## Small bowel biopsy

A small bowel biopsy is required to confirm the diagnosis of celiac disease. The biopsy is performed during an endoscopy usually by gastroenterologists. [58]

## Screening for celiac disease

Screening serologic tests are used to identify individuals at risk for celiac disease, such as those experiencing celiac disease symptoms, first-degree relatives of individuals with celiac disease, and people with associated autoimmune disorders or other conditions, especially type 1 diabetes, autoimmune thyroid disease, Down syndrome, Turner syndrome, Williams syndrome, and selective immunoglobulin A (IgA) deficiency. The diagnosis is confirmed with a small bowel biopsy or a skin biopsy in those with dermatitis herpetiformis. [57] [59]

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Testing for celiac disease should take place before a person starts a gluten-free diet since removing gluten from the diet interferes with the ability to detect the disease. After 6 to 12 months of maintaining a strict gluten-free diet, symptoms should disappear, blood tests for the disease should improve, and any small bowel injury should begin to heal. Children who are seriously ill on initial diagnosis sometimes require bowel rest and total intravenous nutrition. [2] [12] [14] [28] [55] [56] [57] [58]

Additional testing may be recommended after celiac disease diagnosis to assess nutritional status, including mineral and vitamin A, B12, D, and E levels, along with hemoglobin, and liver enzymes. Bone health also may be evaluated with a bone density scan. [12] [55]

Despite celiac disease being a common genetic disorder affecting approximately one in every 100 people worldwide, up to 80% of people with celiac disease remain undiagnosed, even in developed countries. Many individuals do not exhibit clinically significant signs of celiac disease; instead, most have atypical signs or vague symptoms, making diagnosis difficult or leading to delays. On average, the delay in diagnosing celiac disease is between 4 and 10 years after symptoms begin. Early diagnosis is critical to prevent long-term complications. [11] [14] [35]

**Differential diagnosis**

The differential diagnoses for celiac disease include various conditions that present with similar gastrointestinal or systemic symptoms. Accurate diagnosis is crucial to prevent unnecessary dietary restrictions.

**Differential diagnosis** [18] [60] [61] [62]

| Disorder | Signs / symptoms* |
|---|---|
| Non-celiac gluten sensitivity | Abdominal bloating and pain, diarrhea, constipation. |
| Irritable bowel syndrome | Abdominal pain, cramping, and bloating, diarrhea, constipation. |
| Inflammatory bowel disease (e.g., Crohn's disease, ulcerative colitis) | Abdominal discomfort, diarrhea, weight loss. |
| Lactose intolerance | Abdominal bloating and cramping, gas, diarrhea. Can occur in celiac disease due to villous atrophy but may develop independent of celiac disease. |
| Small intestinal bacterial overgrowth | Abdominal bloating, diarrhea, gas, nausea, fatigue, malabsorption, unintended weight loss. |
| Food allergies or sensitivities (e.g., fructose intolerance) | Abdominal bloating, diarrhea. |
| Autoimmune enteropathy | Diarrhea, histopathologic findings similar to celiac disease |
| Tropical sprue | Diarrhea, anemia, weight loss, nausea, abdominal cramps, fatigue. Malabsorption with villous atrophy on biopsy. Responds to antibiotic treatment. Endemic in certain tropical regions. |
| Giardiasis | Diarrhea, abdominal cramping, nausea, malabsorption caused by *Giardia* protozoa infection of the small intestine. |
| Pancreatic insufficiency | Malabsorption, steatorrhea. |
| Drug-induced enteropathy | Certain drugs can induce enteropathy with villous atrophy. |

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| Disorder | Signs / symptoms* |
|---|---|
| (e.g., nonsteroidal anti-inflammatory drugs, olmesartan, chemotherapeutic agents, immunosuppressants, antibiotics) | Diarrhea, weight loss, abdominal pain. Intestinal biopsy reveals histologic findings consistent with enteropathy but not specifically celiac disease. |
| Cow milk protein allergy, wheat allergy gastroesophageal reflux disease, and cystic fibrosis in children | Abdominal discomfort, malabsorption, poor growth. |

*Nonexhaustive list

**Treatment**

Currently, the only treatment to avoid the symptoms and complications of celiac disease is a strict gluten-free diet and supplements to replace any serious nutrient deficiencies. Individuals with celiac disease must avoid foods containing wheat, rye, barley, and hybrid varieties of these grains.

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Gluten can be present in food products due to:

- Using ingredients derived from gluten-containing grains.
- Cross-contamination during manufacturing or distribution.

Since gluten is used in many prepackaged foods, it is crucial for those with celiac disease to carefully review food labels to prevent acute and chronic adverse health effects. [7] [12] [28]

The response to a gluten-free diet is usually rapid, with symptoms often starting to resolve in one to two weeks. Children generally heal more quickly than adults, as it usually takes three to six months for children and potentially several years for complete healing in adults. However, ingesting even small amounts of food containing gluten may prevent remission or induce relapse.

Following a strict gluten-free diet also lowers the risk of developing serious long-term complications associated with untreated celiac disease. Since some foods excluded from a gluten-free diet are essential sources of nutrients such as fibre, iron, and B vitamins, it is crucial to maintain a dietary pattern that prevents nutritional deficiencies. Furthermore, gluten-free products can be high in fat and sugar. Thus, consulting a registered dietitian is advised. [2] [12] [22] [55]

<u>Vitamin and mineral supplements</u>

Vitamin and mineral supplements may be recommended if anemia or nutritional deficiencies are severe, such as:

- Calcium
- Copper
- Folic acid
- Iron
- Vitamin B12
- Vitamin D
- Vitamin K
- Zinc [12] [55]

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**Follow-up care**
Medical follow-up at regular intervals helps ensure symptoms have responded to a gluten-free diet. The healthcare team may monitor the response with blood tests. Nutritional markers also are checked regularly. [55]

Small-bowel biopsy may be repeated three to six months after following a gluten-free diet. If abnormalities persist, other causes of villous atrophy (e.g., lymphoma) should be considered. [12]

**Nonresponsive celiac disease**
Nonresponsive celiac disease is persistent or recurrent symptoms despite following a gluten-free diet. This condition is often due to diet contamination with gluten. A systematic workup is usually required to identify other conditions causing ongoing symptoms (e.g., irritable bowel syndrome, pancreatic insufficiency, lactose intolerance, etc.). Working with a registered dietitian can help to avoid sources of gluten. [4] [63]

**Refractory celiac disease**
Refractory celiac disease (RCD) is a rare form of celiac disease that does not improve after following a strict gluten-free diet for at least 12 months. RCD affects 1-2% of individuals with celiac disease, mainly adults over 50. Individuals with RCD continue to have symptoms (e.g., unintentional weight loss, chronic diarrhea, abdominal pain) or signs of malabsorption (e.g., anemia).

There are two types of RCD:
- Type I RCD usually responds well to treatment and is often managed with steroid therapy (e.g., budesonide), which helps suppress the immune system.
- Type II RCD is more challenging to treat, carries a higher risk of malnutrition and serious complications, and is associated with poorer prognosis.

RCD) is diagnosed by ruling out other conditions that damage the small intestine, such as lymphoma, Crohn's disease, and small intestinal bacterial overgrowth. [63] [64]

**Sources of gluten**
Gluten sources must be declared when a prepackaged food contains gluten protein, modified gluten protein, or gluten protein fractions from barley, rye, wheat, triticale, and oats. Canadian *Food and Drug Regulations* require gluten sources to be declared by the grain name, such as wheat, barley, rye, triticale, or oats. [1]

Oats do not contain gluten. However, they are frequently grown, harvested, and transported near other gluten-containing grains, which can lead to cross-contamination. Oats specifically produced to avoid cross-contamination are known as uncontaminated or pure oats. Uncontaminated oats are labelled in the ingredients list as gluten-free oats and are generally safe for most individuals with celiac disease to consume. [1]

In the past, some products have used other names for wheat on their labels. These names are not permitted in Canada without the word wheat also appearing on the label.

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Anyone with celiac disease or a gluten-related disorder should avoid eating food products containing gluten or potential sources of gluten. [21]

**Foods to avoid*** [21]

| | | | |
|---|---|---|---|
| • Atta<br>• Bulgur<br>• Couscous<br>• Durum | • Einkorn<br>• Emmer<br>• Farina<br>• Fu | • Graham<br>• High-gluten and high-protein flour<br>• Kamut | • Seitan<br>• Semolina<br>• Spelt (dinkel, farro) |

*Nonexhaustive list

**Food products containing or often contain wheat*** [21] [55]

| | | |
|---|---|---|
| • Breads and baked goods<br>• Baking mixes, powder<br>• Batter-fried foods<br>• Beer, larger, ale<br>• Candy<br>• Cereal-based coffee substitutes (chicory, barley)<br>• Chicken and beef broth (cans, bouillon cubes)<br>• Croutons<br>• Deli meats, hot dogs, surimi | • Falafel<br>• Flour<br>• Gelatinized starch, modified starch, food starch<br>• Host (communion, altar bread, wafers)<br>• Hydrolyzed plant protein<br>• Ice cream<br>• Imitation meats (e.g., bacon) or seafood | • Pie fillings, puddings<br>• Prepared ketchup and mustard<br>• Sauces (e.g., chutney, soy, tamari sauce)<br>• Salad dressings<br>• Seasonings<br>• Soups<br>• Snack foods (e.g., crackers, cereal, seasoned tortilla and potato chips) |

*Nonexhaustive list

**Food products containing or often contain rye*** [1]

| | |
|---|---|
| • Certain beers<br>• Breads and baked goods | • Flour (normally identified as rye flour)<br>• Triticale (hybrid of wheat and rye) |

*Nonexhaustive list

**Food products containing or often contain barley*** [1]

| | | |
|---|---|---|
| • Barley malt (extract, flavouring, syrup)<br>• Beer | • Breads and baked goods<br>• Flour (normally identified as barley flour) | • Malt vinegar<br>• Malted milk<br>• Yeast extract |

*Nonexhaustive list

**Hidden sources of gluten*** [55] [65]

| | |
|---|---|
| • Preservatives and food stabilizers<br>• Prescription and over-the-counter medications<br>• Vitamin, mineral, herbal, and nutritional supplements<br>• Cosmetics, lip stick, lip gloss, lip balm | • Skin and hair products<br>• Envelope and stamp glue<br>• Children's modelling clay (Play dough)<br>• Oral care products (e.g., toothpaste, mouthrinse) |

*Nonexhaustive list

### Gluten-free foods

Foods such as meat, fish, poultry, eggs, nuts, fruits, vegetables, and milk-based items, without additives or seasonings are naturally gluten-free.

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**Naturally gluten-free foods*** [55] [66]

| | | |
|---|---|---|
| • Amaranth<br>• Arrowroot<br>• Beans, lentils, peas, peanuts<br>• Buckwheat groats (kasha)<br>• Cassava<br>• Chia<br>• Corn, cornmeal | • Flax<br>• Gluten-free flours (potato, rice, corn, soy, nut, cassava, amaranth, quinoa, buckwheat, bean)<br>• Gluten-free oats<br>• Millet | • Quinoa<br>• Rice, wild rice<br>• Sorghum<br>• Soy<br>• Tapioca<br>• Teff<br>• Yucca |

*Nonexhaustive list

### Gluten-free diet

Adjusting to a gluten-free diet can be challenging after receiving a diagnosis of celiac disease. Strategies to help manage this transition include the following:

- Choose naturally gluten-free foods and avoid gluten containing foods.
- Avoid products with a “may contain” gluten statement due to a risk of gluten cross-contamination. “May contain” statements for allergens and gluten sources are made voluntarily by food manufacturers. Additionally, wheat-free does not necessarily mean gluten-free.
- Avoid food products that do not have an ingredient list.
- Read labels since manufacturers may change their recipes or use different ingredients for varieties of the same product.
- Choose food products with a gluten-free claim. Canada's *Food and Drug Regulations* outline requirements for using gluten-free claims on prepackaged foods. Products making a gluten-free claim must not contain any ingredients containing gluten and must prevent gluten cross-contamination.
- Work with a registered dietitian to ensure a balanced diet.
- Consult a pharmacist to ensure medications are gluten-free.
- Connect with a mental health professional if experiencing difficulty adjusting to a celiac disease diagnosis or managing the disease. [1] [67] [68]

### Gluten-free products

A gluten-free diet is medically necessary for individuals with a gluten-related disorder, such as celiac disease and wheat allergies. Many individuals believe gluten-free products are healthier than those containing gluten. However, several studies have found gluten-free food products often contain more sugar and fat and less protein than their gluten-containing equivalents. [69]

Alam et al. (2025) compared 39 gluten-free products, such as baked goods, snacks, ready meals, and breakfast items, with their gluten-containing counterparts. They found that, on average, gluten-free products in the United States contain significantly less protein and more sugar and calories. Furthermore, gluten-free products are generally more expensive than those containing gluten. The findings highlight the need for more investment in research and development to create more nutritionally balanced gluten-free products, utilizing locally available ingredients to help reduce costs. [69]

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Approximately 25% of the U.S. population consumes gluten-free products. This figure is far higher than the roughly 6% of individuals with non-celiac gluten sensitivity, 1% of individuals with celiac disease, and even lower percentages of individuals with wheat allergies. This suggests many individuals adopt gluten-free diets for reasons other than medical necessity, which may not offer health or financial benefits. [11] [70] [71] [72]

Many individuals without gluten restrictions are adopting a gluten-free diet, believing it will aid in weight loss, improve skin appearance, and enhance digestive health. Misinformation from various sources, including media, celebrity endorsement, and influential books, has contributed to the misconception that gluten consumption can harm healthy individuals. This trend stems from beliefs that gluten, particularly in wheat and similar grains, may cause health issues, such as weight gain, depression, and arthritis. As a result, many health-conscious consumers have started to reduce or eliminate gluten from their diets, even without medical advice. [69]

The popularity of gluten-free diets has grown significantly, fueling a multi-billion-dollar gluten-free product industry. In 2024, the global market for gluten-free products was valued at $7.28 billion USD and projected to reach $13.81 billion by 2032. [73]

**Health impact**

Following a gluten-free diet that is not medically prescribed can harm gut health by reducing beneficial bacteria (e.g., *Bifidobacterium* and *Faecalibacterium*). A decrease in beneficial bacteria can lead to an overgrowth of harmful bacteria (e.g., *Escherichia coli*). Gluten-free diets can also result in nutritional deficiencies and changes in body mass index, which may increase vulnerability to various diseases. Individuals without a gluten-related disorder should be aware of these health risks before adopting a gluten-free diet and work with a registered dietitian to ensure a balanced diet. [69]

Many gluten-free products lack nutritional value and quality and are high in sugar, increasing the risk for dental caries. The growing availability and popularity of gluten-free products, especially among individuals without a gluten-related disorder, highlight the importance for oral health practitioners to be aware of the effects a gluten-free diet can have on overall and oral health. [69]

**Cost**

Life-long adherence to a gluten-free diet is crucial for managing celiac disease. A significant challenge associated with a gluten-free diet is the high cost of gluten-free foods. Gluten-free foods typically cost 150-500% more than their conventional counterparts, representing an average additional cost of $1,000 per year per adult. This financial burden may contribute to a higher risk of food insecurity.[17] [74] [75]

A cross-Canada online survey by Wang et al. (2024) of over 650 parents with children on a gluten-free diet found 47% experienced food insecurity. Among these households, more than 30% reported low to very low levels of food accessibility.

[17] Food insecurity is the inability to access adequate, affordable, and nutritious food due to financial constraints.

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The challenge of affordability often prevented children with celiac disease from adhering to a gluten-free diet. As a result, they tended to eat fewer fresh fruits, vegetables, and gluten-free grains and consumed more processed gluten-free foods, which can be deficient in essential vitamins and minerals.

Ninety-two percent of the households surveyed reported spending significantly more on gluten-free foods over the past year. Approximately 12% of parents reported they had to find ways to deal with the high cost of gluten-free foods, including eating less or lower quality food themselves and cutting back on entertainment and family activities. These findings highlight the urgent need to improve government policies to make gluten-free food affordable for families.

Although Canada offers a tax credit for gluten-free food products, the calculation process is complex, and only a small percentage of expenses can be applied as a credit. A 2022 survey revealed 71.4% of respondents did not claim the credit due to the difficulty of tracking all purchases and calculating the additional costs. Moreover, the credit does not benefit low-income households below the tax threshold, leaving them at a higher risk of food insecurity. These findings underscore the urgent need for policy interventions to improve the affordability and availability of gluten-free food to support individuals in achieving optimal health, considering a gluten-free diet is the only treatment for celiac disease. [74] [76] [77]

**Oral healthcare**

Oral health practitioners can assist clients with undiagnosed celiac disease by knowing the signs and symptoms of celiac disease. For example, consider celiac disease in any client with enamel defects, recurrent oral aphthous ulcers, or both. If these conditions are present, ask about other celiac disease symptoms, such as abdominal pain, diarrhea, weight loss, poor growth, anemia, and extreme fatigue, remembering that the absence of these symptoms does not rule out celiac disease.

Follow-up inquiries can include:

- Does the client have other autoimmune diseases, especially type 1 diabetes and autoimmune thyroid disease? The presence of an autoimmune disease further increases the likelihood of celiac disease.
- Does the client have a first- or second-degree relative with celiac disease? Having a family member with celiac disease increases the possibility of celiac disease.

If celiac disease is suspected, refer the client to a medical provider for screening. Prompt referral and timely diagnosis can reduce long-term complications. Early diagnosis is especially important for children. Dental enamel defects are common in children who develop celiac disease before age seven. However, children with celiac disease can develop healthy tooth enamel if they follow a gluten-free diet before their adult teeth fully form.

Enamel defects are irreversible and do not improve with a gluten-free diet. Esthetic appearance can be enhanced with bonding and veneers in older children and adults.

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Adhering to a strict gluten-free diet is also key to improving soft tissue manifestations, such as aphthous stomatitis and glossitis.

Individuals with celiac disease must avoid gluten-containing products, including oral care products and dental materials. Knowing the ingredients in dental products is essential for managing this condition. Always check the ingredient lists, and when possible, choose products labelled as gluten-free.

Potential sources of gluten include:

- Toothpaste
- Mouthrinse
- Dental floss (especially flavoured)
- Teeth whitening products (e.g., gels, strips, rinses)
- Polishing pastes
- Fluoride gels and varnishes
- Oral appliances and materials made with the acrylic resin methyl methacrylate (e.g., orthodontic retainers, dentures, denture repair materials [22] [47] [78]

**Take home messages**

- Celiac disease is an autoimmune disease of the small intestine triggered by ingesting dietary gluten in genetically susceptible individuals. The only effective treatment is a lifelong gluten-free diet.
- Symptoms of celiac disease are highly variable and consist of intestinal and/or extraintestinal symptoms, while some individuals may be asymptomatic.
- Celiac disease should be considered in clients with unexplained enamel defects or recurrent aphthous ulcers. Oral health practitioners play a critical role in identifying individuals who may have undiagnosed celiac disease and in referring them for appropriate screening. Early diagnosis of this condition is essential to prevent long-term complications.
- Celiac disease can affect oral and systemic health and overall well-being, highlighting the need for integrated care involving oral health practitioners, physicians, gastroenterologists, nurse practitioners, registered dietitians, pharmacists, and mental health professionals. Interdisciplinary collaboration is vital to recognizing, diagnosing, treating, and educating clients with celiac disease.

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**Client Resources**

The Gluten-Free Diet and Gluten-Related Disorders: Getting Started
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Blood Testing for Celiac Disease
https://www.celiac.ca/pdfs/blood%20test-rev.pdf

Let's Connect - Find Your Community and Get Support
https://www.celiac.ca/living-gluten-free/peer-support/

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