All about Gluten?
Celiac disease, gluten sensitivity, wheat sensitivity, and other considerations

Dr. Raquel Garzon, RDN
NMSU Cooperative Extension Services
Nutrition and Wellness State Specialist

About the College: The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico, improving the lives of New Mexicans through academic, research, and extension programs.
"I hope this is gluten-free!"
“The boss is coming over to chew you out and bite your head off. But first, I need to make sure you’re gluten free.”
Definitions

**Gluten**: A heterogenous mix of water-insoluble storage proteins in cereal grains, wheat, rye, and barley, that gives dough its elastic properties; it consists of two fractions: prolamins and glutelins; the fractions of wheat are gliadins and glutenins

**Prolamins**: Difficult to digest; the high content of proline and glutamine content in gluten that prevents complete breakdown by digestive enzymes; this is the component that causes issues in celiac disease

**Gliadin**: The prolamin in wheat

**Secalin**: The prolamin in rye

**Hordein**: The prolamin in barley

**Avenin**: The prolamin in oats

**FODMAPs**: Fermentable Oligo-, Di-, and Mono-saccharides And Polyols; short chain carbohydrates poorly absorbed in the small intestine; osmotically active and highly fermentable by gut bacteria
History of wheat and gluten in our diets

Wheat was introduced 10,000 years ago during the Agricultural Revolution (relatively new considering the previous 2.5 million years without it)

Wheat and barley were the first cereals that were domesticated: wild einkorn and emmer wheat

The gliadin of the original einkorn lacks toxicity for celiac disease

Cultivation and repeated harvesting of wheat with larger grains and with ears resistant to harvesting and migration of people and wheat domestication contributed to the development of celiac

5,000 years ago, wheat reached Ireland and Spain; 4,000 years ago it reached China

Agricultural revolution introducing wheat also coincided with domestication of cattle, various species of birds: exposing the body with a variety of food antigens previously unknown
History of Celiac disease

Some human bodies adapted to tolerate wheat, but others did not

It became a major killer of infants for many generations

2,000 years ago, a Greek physician named Aretaeus of Cappadocia first described the condition he called koilakos (meaning abdomen)

In 2,000 years ago, a Greek physician named Aretaeus of Cappadocia first described the condition he called koilakos (meaning abdomen)

In 1887, Dr. Samuel Gee described “celiac affection’ and concluded that a diet must be followed

In 1887, Dr. Samuel Gee described “celiac affection’ and concluded that a diet must be followed

In 1924, Dr. Sidney Haas described treating celiac children with a diet consisting of mostly bananas; was the only treatment for some time

In 1924, Dr. Sidney Haas described treating celiac children with a diet consisting of mostly bananas; was the only treatment for some time

In 1952, Dicke, Weijers, and van de Kamer documented the role of gluten from wheat and rye in causing damage to intestinal mucosa

In 1952, Dicke, Weijers, and van de Kamer documented the role of gluten from wheat and rye in causing damage to intestinal mucosa

In 1956, Dr. Margot Shiner developed diagnosis via biopsy

In 1956, Dr. Margot Shiner developed diagnosis via biopsy

In 1990, a blood test was developed identifying antibodies produced by gluten

In 1990, a blood test was developed identifying antibodies produced by gluten

In 1997, Dr. Detlef Schuppan introduces simple blood test to screen for celiac disease

In 1997, Dr. Detlef Schuppan introduces simple blood test to screen for celiac disease
The Development of Celiac Disease

- Genetic predisposition
- A diet with gluten
- An environmental trigger

Celiac disease

Highest prevalence is in Sahawari (in Western Sahara) and in Egypt; found across diverse populations.

30-40% of people carry the genes associated with celiac disease.

Known triggers: pregnancy, surgery, accident or injury, emotional stress, illness, gut permeability.
Celiac disease

Autoimmune disease triggered by ingesting gluten: involves the innate and adaptive (complicated and sophisticated) immune systems both; results in cells that attack body tissues

- Damages the small intestine
- Immune reaction causes damage to villi that absorb nutrients
- Exposure to gluten overtime causes the villi to flatten
- Flattened villi can no longer absorb nutrients
- 1 in 133 people in the US estimated to have celiac disease
- If aunt, uncle, or cousin has celiac increases risk to 1 in 39
- If parent, child, or sibling has celiac increases risk to 1 in 22
Depiction of the intestinal mucosa with emphasis on the factors involved in the development of celiac disease in individuals with HLA-DQ2/DQ8 positive.
Other autoimmune, gluten-related conditions

**Dermatitis Herpetiformis**
- Itchy skin rash with red bumps or fluid-filled blisters;
- Most likely on buttocks, knees, elbows, back of neck, scalp, groin, or face.
- Diagnosed with a skin biopsy
- Caused by consuming gluten and requires a gluten-free diet

**Gluten Ataxia**
- Damage to the cerebellum in the brain
- Causes confusion, disorientation, issues with fine movements and balance
- Damage to the brain is permanent and cumulative
- Removal of gluten if experiencing symptoms and doctors cannot find another cause
- Gluten-free diet prevents further damage and progression

**Other Autoimmune Diseases**
- Having other autoimmune diseases, such as rheumatoid arthritis, lupus, thyroid disease, type 1 diabetes, increase the risk of celiac disease
- Get tested for celiac disease

"Every time I am exposed to gluten, I lose a little bit of something I used to be able to do."
Non-celiac, Gluten Sensitivity

- Not autoimmune disease; only involves the innate immune system (not adaptive immune system)
- Immune reaction to gliadin and antibodies are created in the small intestine; fights gluten directly
- Inflammation occurs both inside and outside the intestinal system
- Does not attack the intestinal villi as is seen in celiac disease
- Symptoms can mimic celiac disease, but may have less digestive symptoms and instead have bone or joint pain, muscle cramps, fatigue, weight issues
- Gluten sensitivity affects about 6 times more people than celiac disease (about 1 in 14)
- No specific, definitive diagnostic test
- In some cases, gluten sensitivity symptoms may appear before celiac disease can be diagnosed
- Those with gluten sensitivity likely to have other food sensitivities (FODMAP)
## Symptoms of Celiac disease

- **Steatorrhea**: diarrhea characterized by greasy, foul-smelling stool that tends to float (only 1/3 people)
- Abdominal pain, bloating, gas
- Poor growth in children
- Vitamin deficiencies and anemia
- Weight loss or inability to gain weight
- Tooth decay
- Missed periods, infertility in women
- Low bone density
- No physical symptoms until severe progression of the disease (silent celiac disease)
Symptoms in celiac and other autoimmune gluten disorders, not associated with gluten sensitivity

- Skin lesions, sleep issues, psychosis
- Balance disorders, peripheral neuropathy, epileptic seizures, fibromyalgia
- Malabsorption: osteopenia and osteoporosis, infertility, miscarriage, neural tube defects, low birth weight, short stature, failure to thrive, anemia
- Vitamin deficiencies: B vitamins, folate, vitamin A, vitamin D, and vitamin E
- Mineral deficiencies: Iron, magnesium, calcium, and zinc
- Weight loss, mouth ulcers, bleed or bruise easily
Symptoms in both Celiac and Gluten Sensitivity

- Fatigue, weakness, dizziness
- GI: Abdominal pain, bloating, diarrhea, constipation, reflux, nausea
- Brain: Poor concentration, memory issues, depression, migraines, ADHD
- Bone and joint pain
Other autoimmune disorder risk with Celiac disease (3 to 10x the normal risk)

<table>
<thead>
<tr>
<th>Type 1 Diabetes</th>
<th>Thyroid: Graves and Hashimoto</th>
<th>Autoimmune liver disease</th>
<th>Celiac hepatitis</th>
<th>Microscopic colitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addison’s disease</td>
<td>Sjogren’s syndrome</td>
<td>Rheumatoid arthritis</td>
<td>Psoriasis</td>
<td>Eczema</td>
</tr>
<tr>
<td>Alopecia areata</td>
<td>Crohn’s disease</td>
<td>Lupus</td>
<td>Cardiomyopathy</td>
<td>Cerebral vasculitis</td>
</tr>
<tr>
<td>Myasthenia gravis</td>
<td>Raynaud’s syndrome</td>
<td>Scleroderma</td>
<td>Ulcerative colitis</td>
<td></td>
</tr>
</tbody>
</table>
Gluten-related testing

DNA tests:
- Genetic testing: HLA-DQ2 and HLA-DQ8 genes are markers for celiac disease; DQ2 is most often associated with celiac (without these genes celiac disease is rare)
- DQ1 genes are associated with Gluten Ataxia

Blood tests:
- tTg (Tissue Transglutamine Antibody (IgA and IgG)) Only positive for autoimmune disorders
- EMA-IgA (Endomysial Antibody) Only positive for autoimmune disorders
- DGP (Deamintated Gliadin Peptide Antibodies (IgA and IgG)) Only positive for autoimmune disorders
- AGA (anti-gliadin antibody: IgA and IgG) Can test positive for gluten-autoimmune and gluten sensitivity

Intestinal Biopsy
- Only positive for autoimmune and typically only for celiac disease

Stool test
- AGA (anti-gliadin antibody: IgA and IgG) – will test positive for gluten-autoimmune and gluten sensitivity
Diagnostic criteria for Gluten sensitivity

- Ingestion of gluten elicits rapid occurrence of intestinal and extra-intestinal symptoms
- Symptoms disappear when gluten is removed from the diet and recur if gluten is re-introduced
- Wheat allergy has been ruled out
- Specific markers of celiac disease have been ruled out
- Intestinal mucosa is normal
- AGA (primarily IgG) may be positive (50% of patients)
- HLA-DQ2 and/or HLA DQ8 may be positive (40% of patients)
Diagnosing Celiac disease

- Average time from onset of symptoms to diagnosis in Europe is about 6 months.
- In the US, time from onset to diagnosis it is estimated to be about 11 years.
- Celiac is in the top 10 of misdiagnosed diseases in the US.
- For every person diagnosed with celiac disease, 140 go undiagnosed.
- This does not count those with gluten sensitivity, which occurs even more frequently.
Common misdiagnoses

- IBS
- CFS or fibromyalgia
- Lupus
- Unexplained anemia
- Migraines
- Unexplained infertility
- Psychological issues
- IBD
- Viral infections
- Food allergies or lactose intolerance
- Parasites
- Gallbladder disease
- Thyroid disease
- Cystic fibrosis
- Acid reflux
- Diverticulosis
- Diabetes
- Eczema or psoriasis
Gluten sensitivity and the Gut

Gluten sensitivity can lead to dysbiosis in the gut with gluten consumption and intestinal permeability, triggering an immune response with pro-inflammatory cytokines, toxins accumulate, the inflammation can reach brain tissue and lead to dysfunction, cognitive impairment, and neurodegenerative disease.

Gluten sensitivity creates gut inflammation and through the gut-brain axis or leaky gut through blood-brain barrier shown to impact neurotransmitters and other neurochemicals, depression, anxiety, bipolar disorder, ADHD, autism, and schizophrenia.

Treatment includes a gluten-free diet, restoring gut microbiome, reducing systemic inflammation, and rehabilitating the gut-brain axis through vagus nerve stimulation.

Gliadin (the prolamin in wheat) consumption seems to increase intestinal permeability in all individuals (celiac, gluten sensitive, and normal controls) likely due to zonulin upregulation.
More on wheat...
Wheat sensitivity not Gluten sensitivity?

It is possible that those with gluten sensitivity are actually responding to other grain proteins (alpha-amylase/trypsin inhibitors), also found in wheat, which can induce an innate immune response.

Another component of wheat, wheat lectin agglutinin, has also shown to increase intestinal permeability and immune activation.

Studies have tested fructan vs. gluten and found that many who believe to have gluten sensitivity and are on a gluten-free diet only responded negatively to fructan, also found in wheat, and not gluten.
Low FODMAP diet and other considerations

A low FODMAP diet is evidence-based for IBS symptoms

FODMAPs found in foods, such as milk, pears, apples, artichoke, garlic, onions, wheat, rye, legumes, and ingredients, such as sorbitol and mannitol

Wheat and rye products contain the highest amount of FODMAPs

Some people who believe they have gluten sensitivity and respond well to a gluten-free diet may instead respond just as well or better to a low FODMAP diet
There is no direct evidence to suggest that following a GF diet outside of celiac disease is dangerous; however:

- Following the diet may lead to underdiagnosing celiac disease
- A GF diet can be restrictive and nutritionally inadequate, especially in fiber and B vitamins
- Following the GF diet in the long-term could have intestinal implications on bowel health if adequate fiber is not consumed
- A GF diet has not shown to improve or aid with weight loss
Common sources of Gluten

- Wheat
- Rye
- Barley
- Oats (not labeled gluten-free)
- Bulgar
- Durum
- Farro
- Farina
- Brewer’s yeast
- Matzoh
- Modified food starch
- Malt (extract, syrup, vinegar, flavoring)
- Kamut
- Semolina
- Spelt
- Soy sauce
- Beer
- Teriyaki sauce
- Worcestershire sauce
- Seitan
Food labeling of gluten-free

- FDA has defined the term “gluten-free” for voluntary use
- Any label bearing this label after August 5, 2014 must meet the agency’s requirements of the gluten-free labeling rule
- Can be labeled “gluten-free” if A. It is an inherently gluten-free food or B. Does not contain an ingredient that is 1. a gluten-containing grain, 2. derived from a gluten-containing grain that has not been processed to remove gluten, or 3. derived from a gluten-containing grain that has been processed to remove gluten, if the use of that ingredient results in the presence of 20ppm or more gluten in the food
- Includes all FDA-regulated packaged foods, including dietary supplements
- Does not include alcoholic beverages
- Imported foods from other countries must comply with gluten-free labeling rule
- Oats that are labeled gluten-free must have less than 20ppm
Food allergen labeling

- Food labels must declare major food allergens in plain language
- Will use wheat as the example:
  - Contains: wheat
  - May contain: wheat
  - Manufactures in a facility that uses wheat ingredients
  - Manufactured in a facility which processes wheat
  - Processed in a facility that uses wheat
  - Manufactured on equipment that processes products containing wheat
  - Manufactured on equipment that uses wheat
  - Manufactured on shared equipment...may contain wheat
WHEN YOU FIND SOMETHING NEW THAT'S GLUTEN FREE
Gluten-free Grains and Flours

- Almond flour
- Amaranth
- Arrowroot
- Brown rice/rice
- Buckwheat
- Coconut flour
- Corn
- Indian ricegrass (Montina)
- Mesquite (pinole)
- Millet
- Oats (if labeled gluten-free)
- Potato flour
- Quinoa
- Sorghum
- Soy flour
- Tapioca flour
- Teff
- Wild rice
Future Prevention/Treatments

- Breastfeeding duration and late introduction of gluten in the diet of at-risk infants
- Gut microbiome manipulation or management
- Gluten-degrading enzymes (proline and glutamine endopeptidases from bateria and fungi)
- Intestinal permeability prevention
- Vaccine
Resources for Celiac disease, Eating Gluten-Free

- Celiac Disease Foundation: [https://celiac.org/](https://celiac.org/)
- Gluten Free Living: [https://www.glutenfreeliving.com/](https://www.glutenfreeliving.com/)
- Beyond Celiac: [https://www.beyondceliac.org/](https://www.beyondceliac.org/)
- Gluten Intolerance Group: [https://www.gluten.org/](https://www.gluten.org/)
- National Celiac Association: [https://www.nationalceliac.org/](https://www.nationalceliac.org/)
- Look for books and apps that support gluten-free, wheat-free, or low FODMAP eating at restaurants, during travel, and at home
THANK YOU!