College of Agricultural, Consumer and Environmental Sciences

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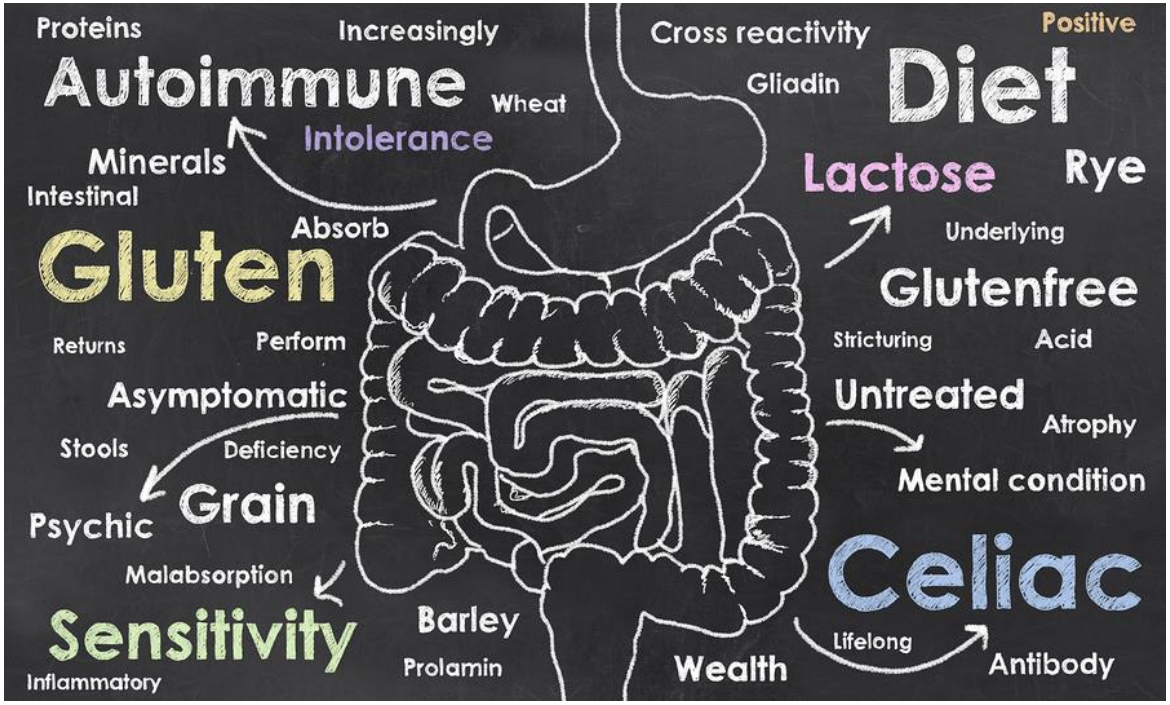

All about Gluten? Celiac disease, gluten sensitivity, wheat sensitivity, and other considerations

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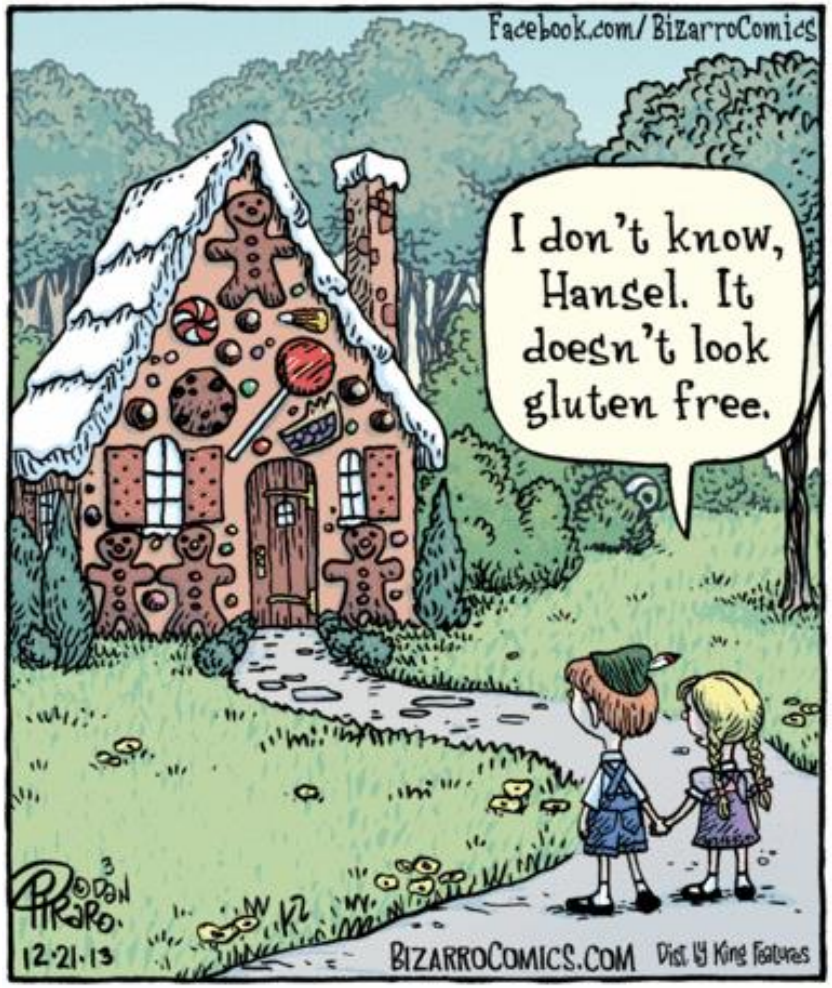
About the College: The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico, improving the lives of New Mexicans through academic, research, and extension programs.

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

↓

In 1956, Dr. Margot Shiner developed diagnosis via biopsy

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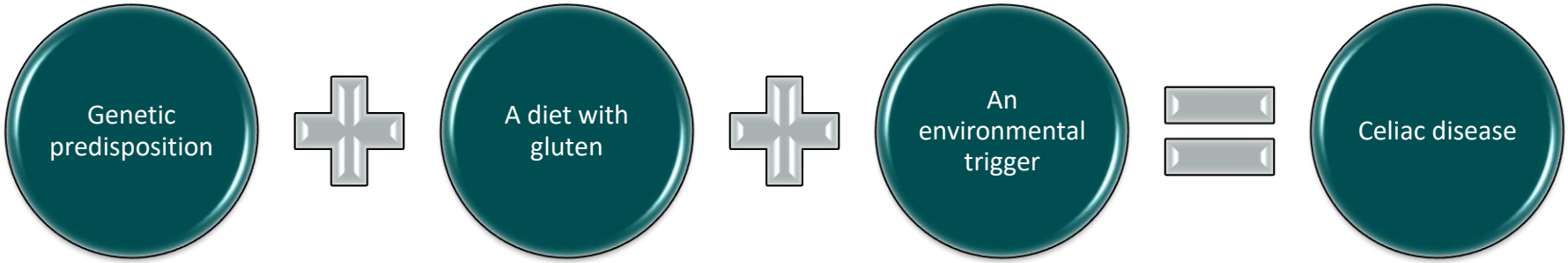
In 1990, a blood test was developed identifying antibodies produced by gluten

→

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

The Development of Celiac



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

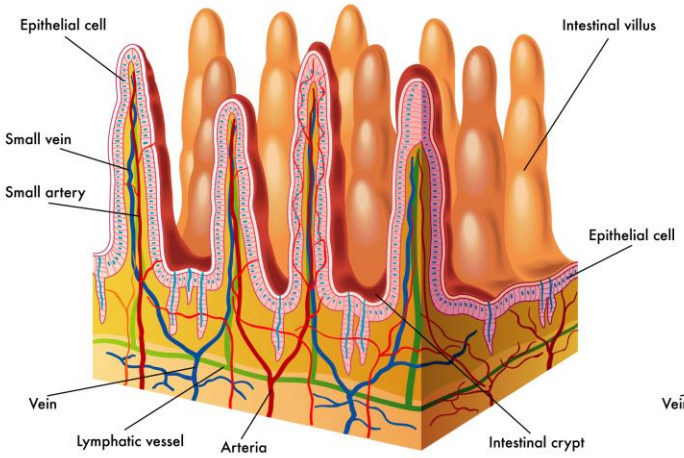
Flattened villi can no longer absorb nutrients

1 in 133 people in the US estimated to have celiac disease

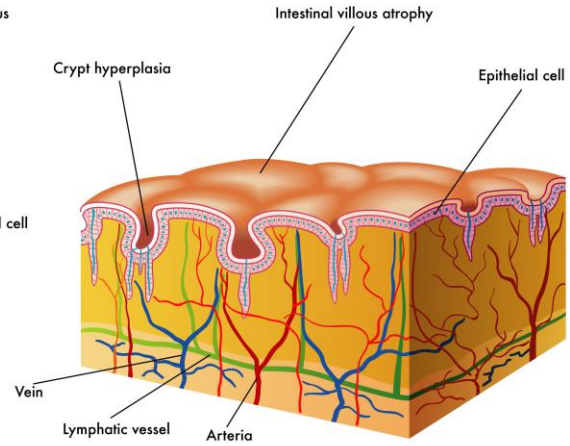
If aunt, uncle, or cousin has celiac increases risk to 1 in 39

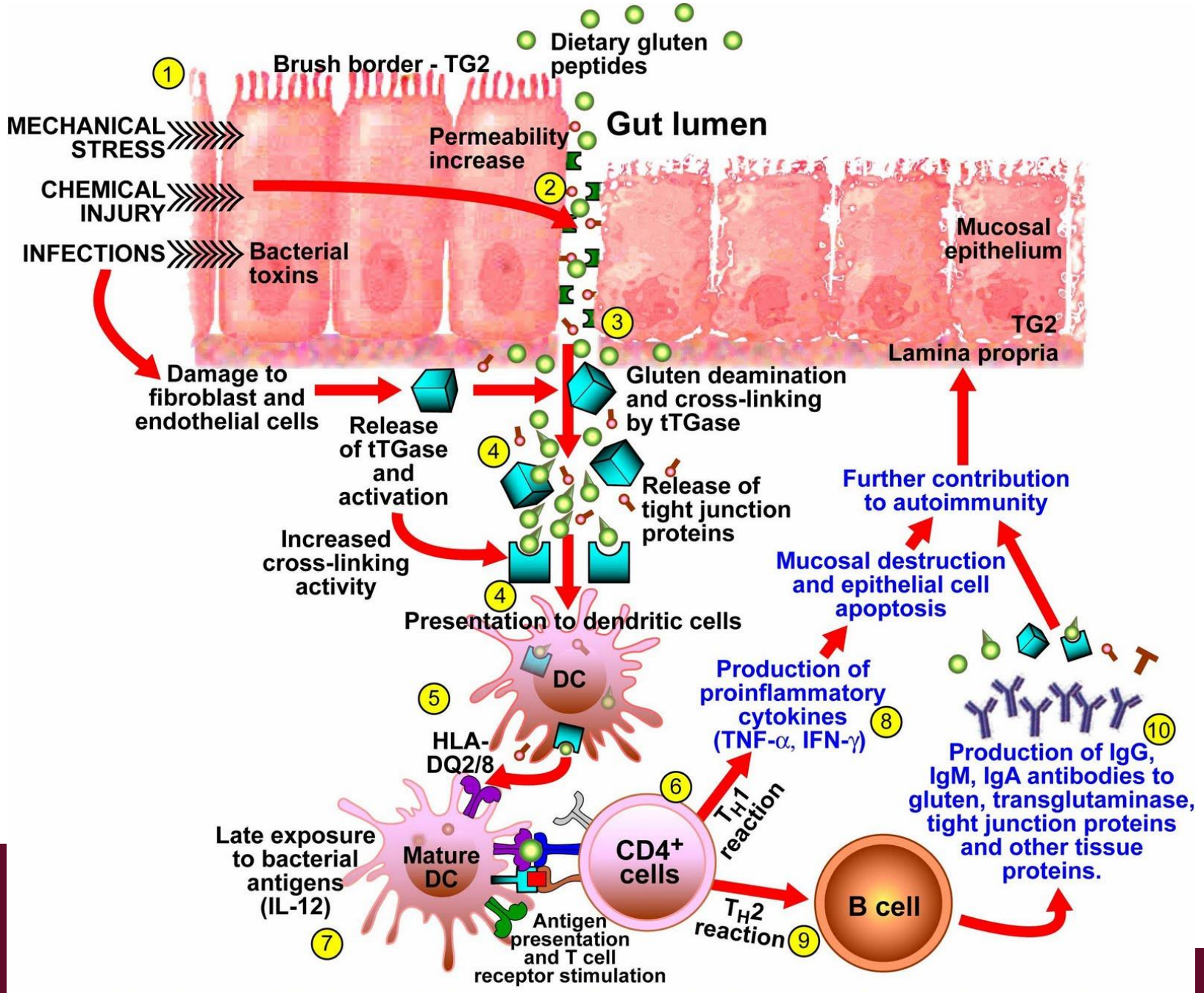
If parent, child, or sibling has celiac increases risk to 1 in 22

NORMAL



CELIAC DISEASE





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

Increased cancer risk: Non-Hodgkin's lymphoma, enteropathy-associated T-cell lymphoma, adenocarcinoma of the small intestine, and thyroid cancer

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)

Type 1 Diabetes	Thyroid: Graves and Hashimoto	Autoimmune liver disease	Celiac hepatitis	Microscopic colitis
Addison's disease	Sjogren's syndrome	Rheumatoid arthritis	Psoriasis	Eczema
Alopecia areata	Crohn's disease	Lupus	Cardiomyopathy	Cerebral vasculitis
Myasthenia gravis	Raynaud's syndrome	Scleroderma	Ulcerative colitis	

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 (Deaminated 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 agglutin, 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

Gluten-free just because?

- 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


GLUTEN
FREE

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

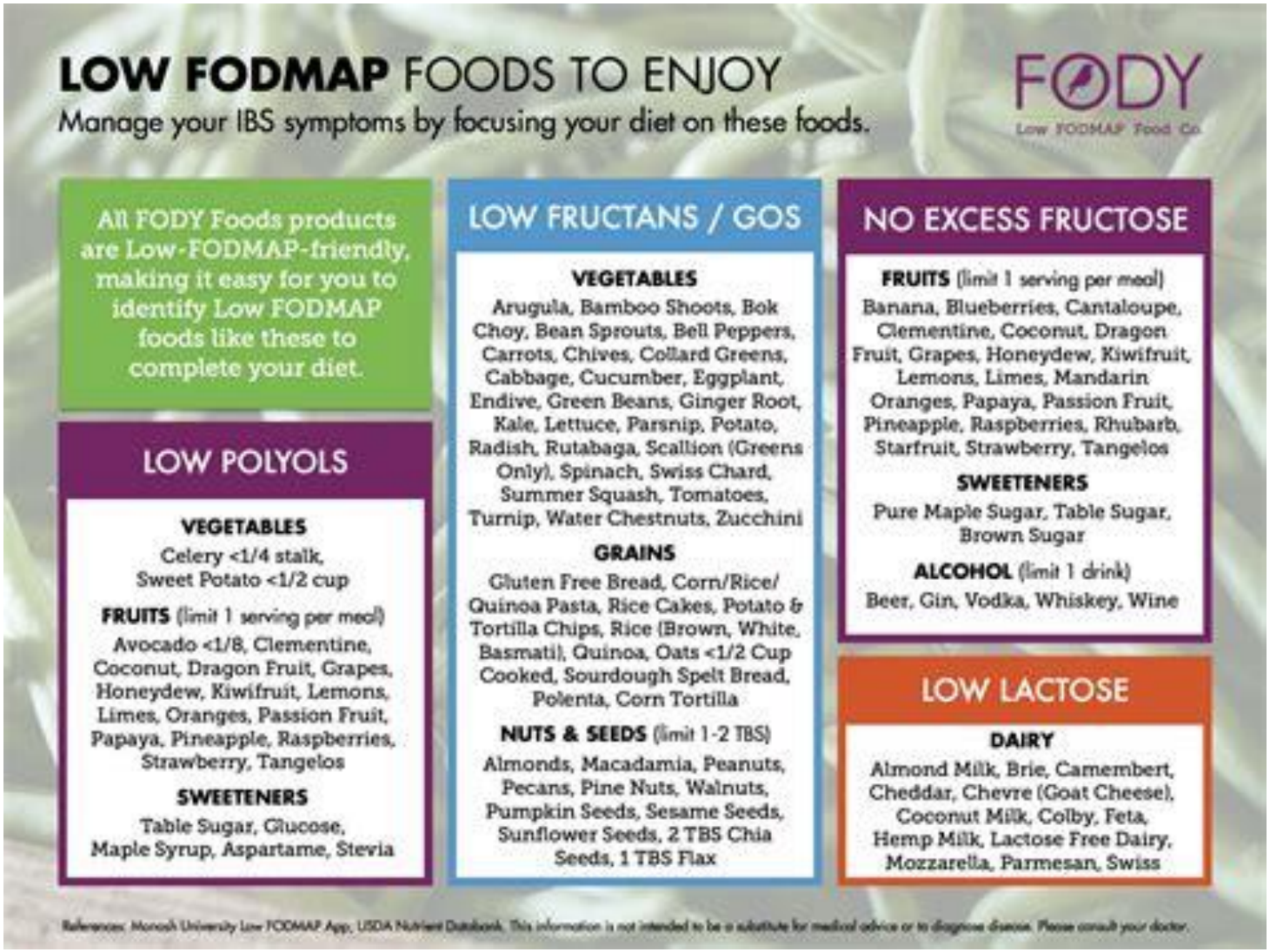
Food allergen labeling

- 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 THATS
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	


LOW FODMAP FOODS TO ENJOY
Manage your IBS symptoms by focusing your diet on these foods.
FODY
Low FODMAP Food Co
All FODY Foods products are Low-FODMAP-friendly, making it easy for you to identify Low FODMAP foods like these to complete your diet.
LOW POLYOLS
VEGETABLES
Celery <1/4 stalk, Sweet Potato <1/2 cup
FRUITS (limit 1 serving per meal)
Avocado <1/8, Clementine, Coconut, Dragon Fruit, Grapes, Honeydew, Kiwifruit, Lemons, Limes, Oranges, Passion Fruit, Papaya, Pineapple, Raspberries, Strawberry, Tangelos
SWEETENERS
Table Sugar, Glucose, Maple Syrup, Aspartame, Stevia
LOW FRUCTANS / GOS
VEGETABLES
Arugula, Bamboo Shoots, Bok Choy, Bean Sprouts, Bell Peppers, Carrots, Chives, Collard Greens, Cabbage, Cucumber, Eggplant, Endive, Green Beans, Ginger Root, Kale, Lettuce, Parsnip, Potato, Radish, Rutabaga, Scallion (Greens Only), Spinach, Swiss Chard, Summer Squash, Tomatoes, Turnip, Water Chestnuts, Zucchini
GRAINS
Gluten Free Bread, Corn/Rice/Quinoa Pasta, Rice Cakes, Potato & Tortilla Chips, Rice (Brown, White, Basmati), Quinoa, Oats <1/2 Cup Cooked, Sourdough Spelt Bread, Polenta, Corn Tortilla
NUTS & SEEDS (limit 1-2 TBS)
Almonds, Macadamia, Peanuts, Pecans, Pine Nuts, Walnuts, Pumpkin Seeds, Sesame Seeds, Sunflower Seeds, 2 TBS Chia Seeds, 1 TBS Flax
NO EXCESS FRUCTOSE
FRUITS (limit 1 serving per meal)
Banana, Blueberries, Cantaloupe, Clementine, Coconut, Dragon Fruit, Grapes, Honeydew, Kiwifruit, Lemons, Limes, Mandarin Oranges, Papaya, Passion Fruit, Pineapple, Raspberries, Rhubarb, Starfruit, Strawberry, Tangelos
SWEETENERS
Pure Maple Sugar, Table Sugar, Brown Sugar
ALCOHOL (limit 1 drink)
Beer, Gin, Vodka, Whiskey, Wine
LOW LACTOSE
DAIRY
Almond Milk, Brie, Camembert, Cheddar, Chevre (Goat Cheese), Coconut Milk, Colby, Feta, Hemp Milk, Lactose Free Dairy, Mozzarella, Parmesan, Swiss
References: Monash University Low FODMAP App, USDA Nutrient Databank. This information is not intended to be a substitute for medical advice or to diagnose disease. Please consult your doctor.

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/
- Gluten Free Living: https://www.glutenfreeliving.com/
- Beyond Celiac: https://www.beyondceliac.org/
- Gluten Intolerance Group: https://www.gluten.org/
- National Celiac Association: https://www.nationalceliac.org/
- The Celiac Disease Center at Columbia: http://www.celiacdiseasecenter.columbia.edu/
- Look for books and apps that support gluten-free, wheat-free, or low FODMAP eating at restaurants, during travel, and at home


THANK
YOU!