

Gluten: Facts, Factoids and Fallacies

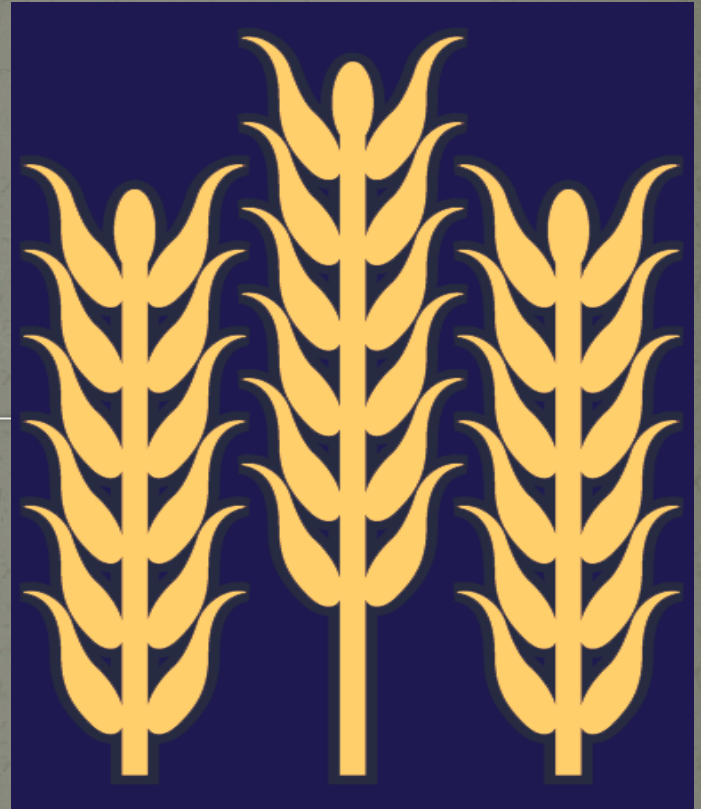
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CIMMYT, March 2018

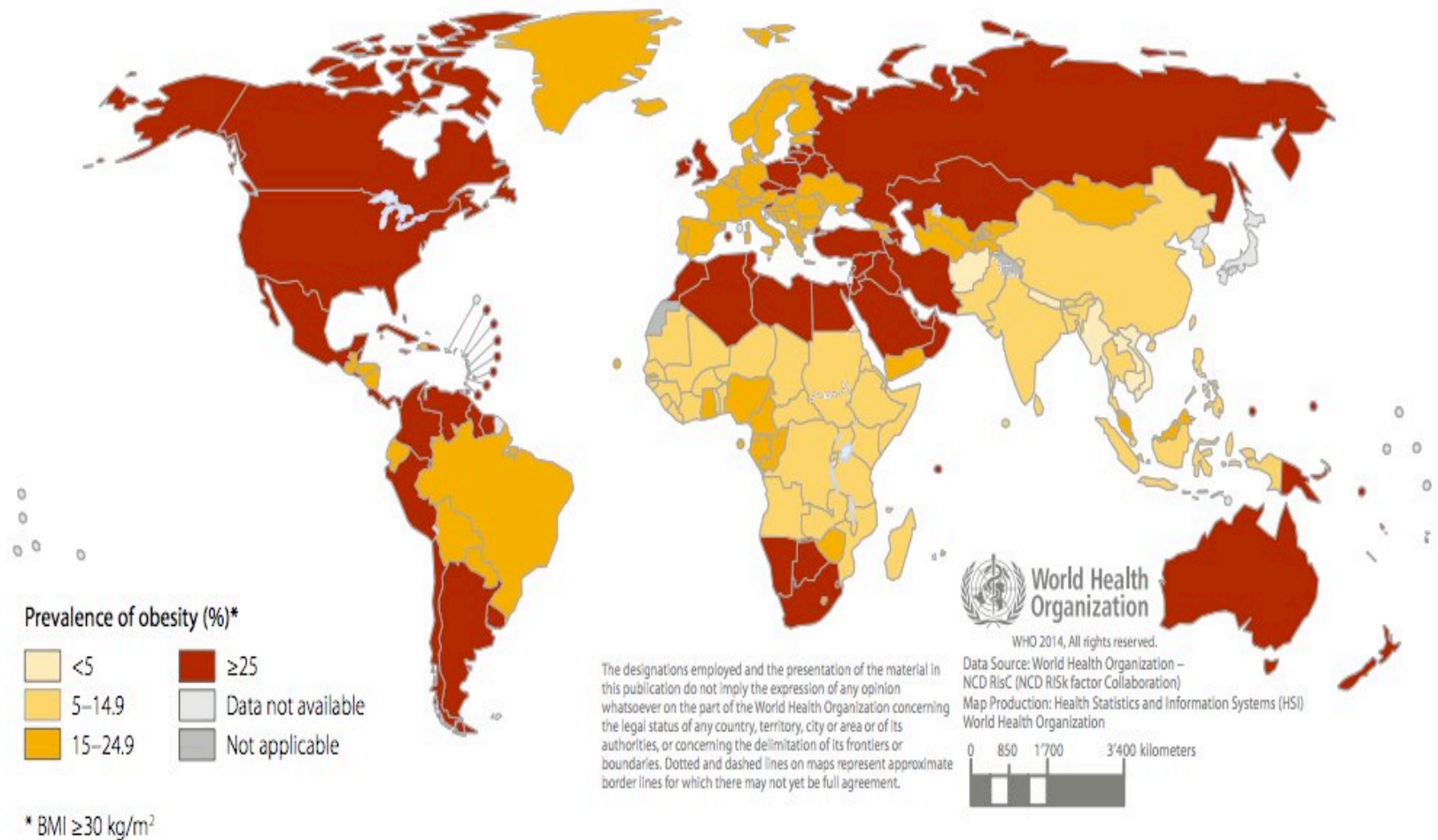
Disclosures

- Scientific Advisor to Grains Food Foundation, Healthy Grains Inst. (Canada), HealthGrain Forum (EU)
- Give speeches and receive honoraria from
 - a variety of associations including ICC and AACC
 - Food companies including Medallion Labs, Quaker Oats, Pepperidge Farms, Tate and Lyle, Cranberry Marketing Institute

What This Talk Will Address

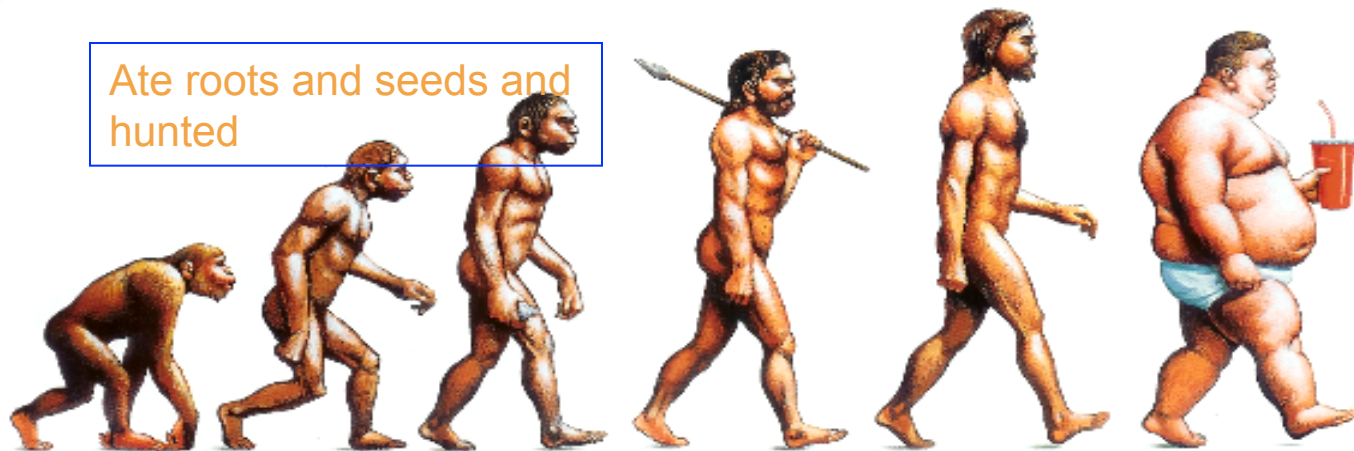
- Today's environment – obesity, type 2 diabetes, anti processed food and clean label, fear of grains, especially refined grains and multiple sources of information.
- Who should avoid gluten and who shouldn't and why.
- Allegations about wheat and gluten-containing foods and the scientific assessment of these claims.
 - Myths, facts, and nutritional ramifications of celiac, gluten-free and grain- free (Paleo) diets.

Fig. 7.2 Age-standardized prevalence of obesity in women aged 18 years and over (BMI ≥ 30 kg/m²), 2014



Obesity Rates on the Rise Worldwide

The shape of things to come



Diets have changed

Gluten is a toxin

ATIs are the
problem

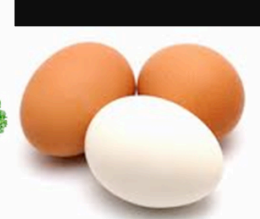
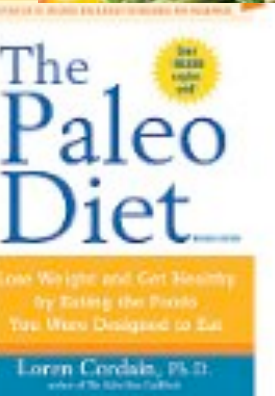
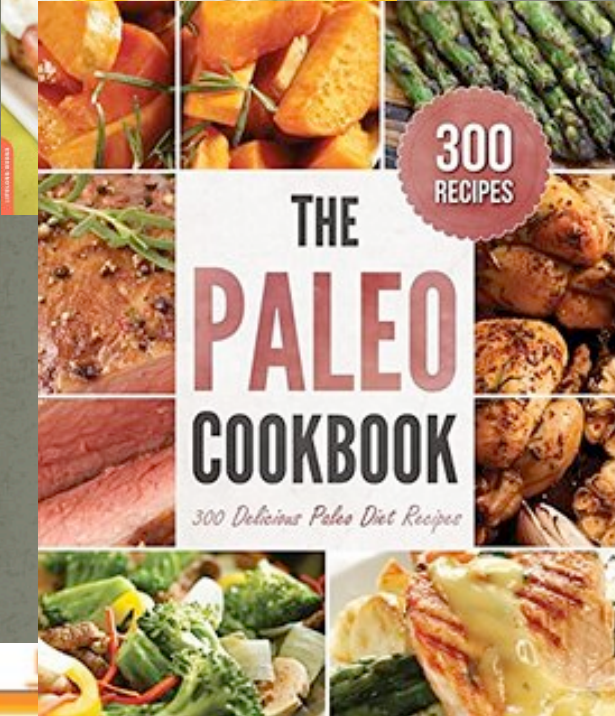
Gluten and
Grains cause
“wheat belly”
and diabetes

Paleo/ no
gluten/ no
grains diets
are the
answer

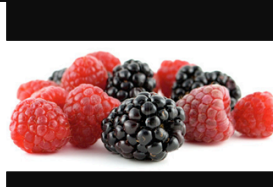
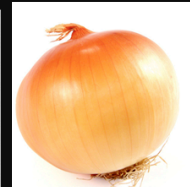
Popular Press Books and Headlines

More Than 150 Easy Favorites to Start Your Day, Gluten- and Grain-Free

Good Morning
PALEO



The Top Ten Paleo Diet Foods



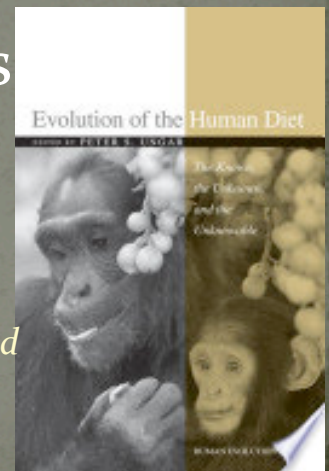
Claim:
Humans did not
evolve to eat grains
and don't need them

Claim: Humans Did Not Evolve to Eat Grain

- Hominids were and are omnivores
- Humans & grains >100,000 yrs
- Dental record evidence
 - Cooked grain DNA
 - Dental calculus of Paleolithic humans
- Cave and cooking evidence*
 - Grains (sorghum, wild maize, others) found in caves
 - Grain DNA on stone tools and in cooking pots indicate processing and cooking of grains.

*Caves in Iraq and the Low Countries; the Americas

Henry, A. et al. *Ethology and Sociobiology* 15 : 219-35.; Unger, P. *The known, the unknown and the unknowable* DOI:10.1016/0162-3095(94)90015-9.



Human Evolution

- Changes with the advent of agriculture
- Humans **evolved** to have **6 copies of amylase**
 - other primates - 2 copies
- Amylase & cooking of CHO enabled ready supply of glucose to the brain
 - Cooked CHO foods may have enabled evolution by increasing the brain size of humans



<http://news.sciencemag.org/evolution/2012/10/raw-food-not-enough-feed-big-brains>
news.nationalgeographic.com/.../121026-human-cooking-e... - A surge in human brain size about 1.8 million years ago is linked to the innovation of *cooking*

Claim - Vegetable fibers Can Substitute for Cereal Fibers

<u>FIBER</u>	<u>LAXATION</u>
	g per g fiber fed
Wheat bran	5.4
Psyllium	4.0
Oats	3.4
Corn	3.3
Legumes	2.2
Pectin	1.2
RS2 resistant starch	1.1
Inulin	1.0

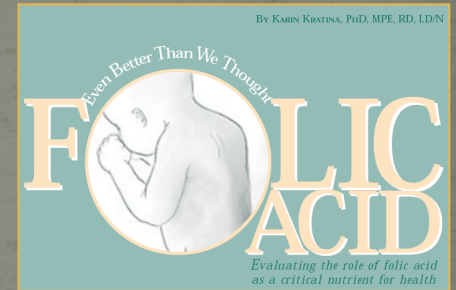


Davis/ Paleo Claim: Wheat Nutrients in Other Foods

FOLATE – mandatory enrichment

- 1998 US and Canada - folate added
- white flour and enriched pasta
- cornmeal products

- ↓46% in the overall rate of NTDs
- US Centers for Disease Control
- 1 of 10 most important health impacts of the last century



Wheat or Gluten Causes -Testimonials

1. Overweight
2. **Abnormal glucose tolerance/ type 2 diabetes mellitus cured
3. **Asthma sufferers either eliminated their inhalers or were cured
4. 38 year old woman with ulcerative colitis and no longer required surgery; IBS improved
5. **26 yr old man unable to walk because of joint pain now walks easily
6. **Energy increased; **Athletic performance - improved
7. **Disturbed sleep - improved
8. **Acid reflux & rash sufferers reported fewer or no symptoms

He points out that wheat is so noxious that ' just one pretzel' will cause the return of symptoms.

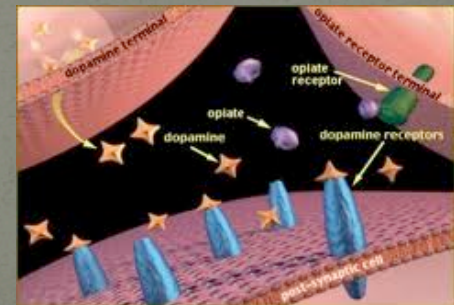
** affected by obesity



Gliadin – New, additive, & obesogenic

Wm Davis claims: Gliadin is a new toxic protein.

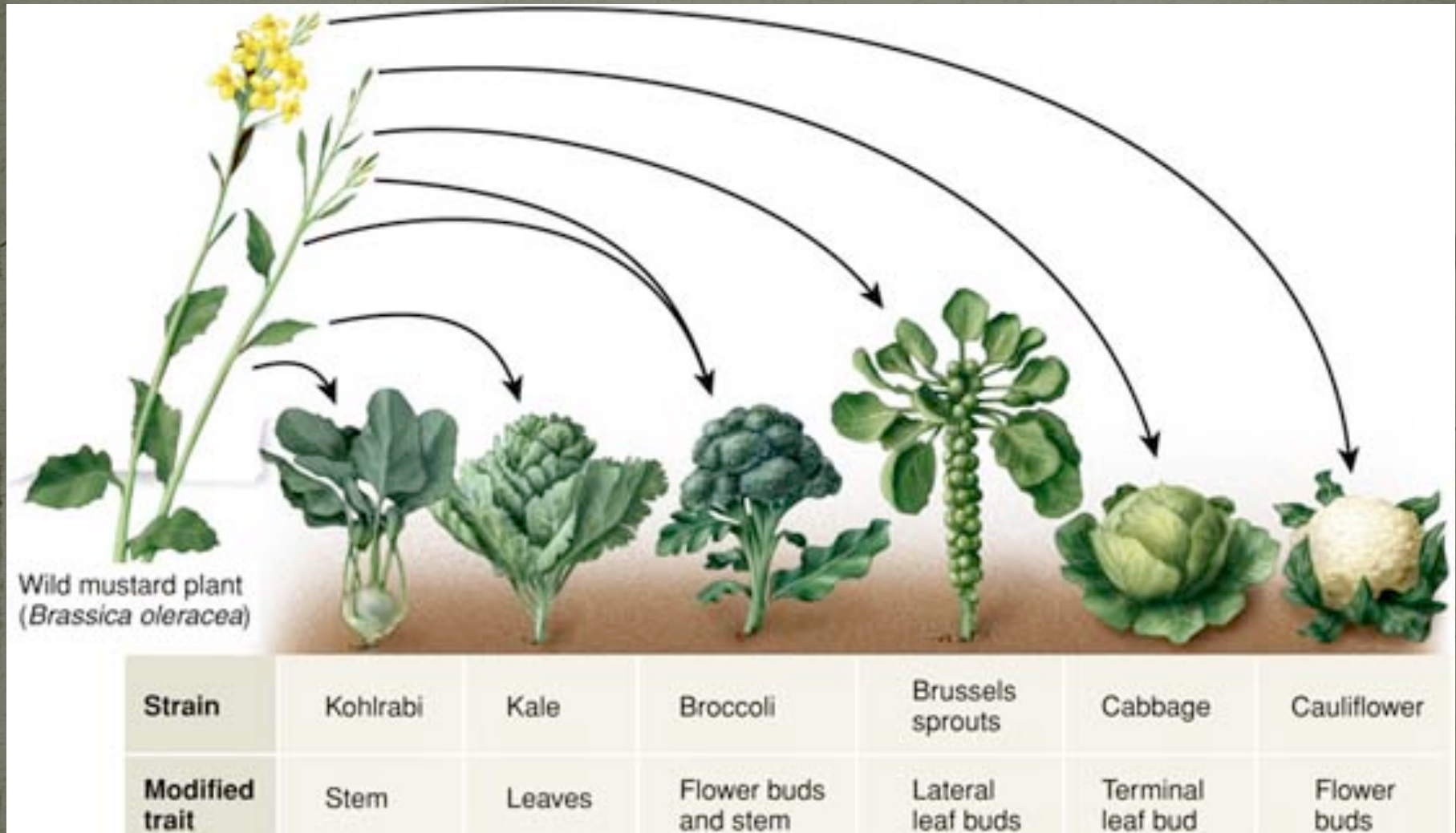
- *“everybody else is susceptible to the gliadin protein that is an opiate. This thing binds into the opiate receptors in your brain and in most people stimulates appetite, such that we consume 440 more calories per day, 365 days per year.”*
- How much weight would we gain if we 440 cal/d more than we need?
- = 46 lbs/yr





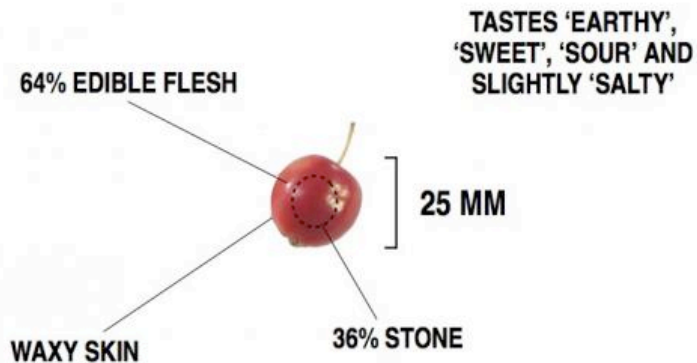
Claim: Modern Wheat Has Been
Bred to Become Toxic

Breeding Has Changed Everything Edible



Breeding Changed Everything Edible

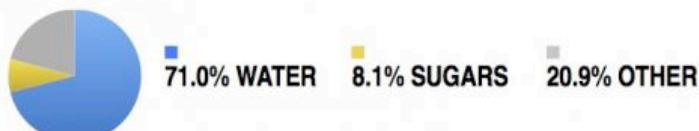
NATURAL PEACH, 4000 B.C.



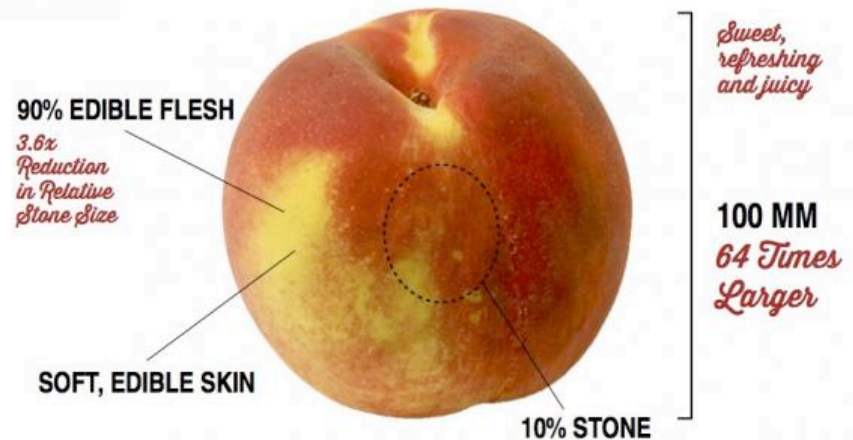
●●● 3 KNOWN VARIETIES



ONLY FOUND IN CHINA



'ARTIFICIAL' PEACH, 2014



~200 VARIETIES

67-Fold Increase



Breeding Changed Everything Edible

NATURAL "WATERMELON" ~3000 B.C.

OPEN WITH A HAMMER
OR SHARP OBJECT

EXTREMELY BITTER TASTE
(SOME VARIETIES ARE BITTER-SWEET)

CAUSES INFLAMMATION

50 MM

18 SEEDS, VERY RICH IN FAT
THEY TASTE NUTTY AND EXTREMELY BITTER

6 KNOWN VARIETIES



FOUND IN
NAMIBIA &
BOTSWANA



80.0% WATER

1.9% SUGARS

18.1% OTHER
MOSTLY STARCH
AND FAT

ARTIFICIAL WATERMELON, 2014

DIFFERENT SHAPES
AVAILABLE:



*Reduces
inflammation!*

Seedless!

OPEN BY DROPPING
FROM ONE METRE
No Hammer Required!



*Deliciously
sweet & so
juicy that it
sometimes
explodes
when ripe*

AVAILABLE IN
FOUR COLOURS:

CREAM
YELLOW
LIME GREEN
RED



~1200 VARIETIES
200-Fold Increase

*Annual Production:
25 Million Tonnes*



*Grown in 15
Countries*
Most are grown in China



91.5% WATER
14% Juicier

6.2% SUGARS
3.3x Sweeter

2.3% OTHER
*Virtually Fat-Free
and Starch-Free*

Breeding Changed Everything Edible



<http://www.foodinsight.org/foods-before-now-gmo-biotechnology>

Breeding Changed Everything Edible



<http://www.foodinsight.org/foods-before-now-gmo-biotechnology>

The Amount of Protein, Starch and Fat in Wheat Has Not Changed

Claim “Wheat we eat these days isn't the wheat your grandma had” Davis

"It's an 18-inch tall plant created by genetic research in the '60s and '70s..."

- No significant changes in wheat proteins or other macro-components

*Kasarda 2014; Chibbar et al 2014; Shewry et al ,
Data from USDA, Health Canada and HealthGrain*

So Jack, did Norman Borlaug sell you this?

Triticum aestivum – Many Varieties

Wheat has many heights, properties

- Ancient & modern wheats' straws 12" to 60"
 - (USDA-National Small Grains Collection)
- Height genes do not code for prolamines eg glutens and gliadins.



Picture Courtesy: R. Chibbar U. Saskatchewan

Reasons to Avoid Wheat and Gluten

Common Allergens

Percent Incidence

Children

- Milk* 2.5
- Eggs* 1.5
- Peanuts 1.4
- Tree nuts 1.1
- **Wheat*** **0.4**
- Soy* 0.4
- Fish 0.1
- Shellfish 0.1
- Sesame 0.1

Adults

- Shellfish 2.0
- Peanut 0.6
- Tree nuts 0.5
- Wheat 0.5
- Fish 0.4
- Sesame 0.1
- Fruits / vegetables est. 0.1 - 4.3

* > 50 % outgrow by age 7

Wheat allergy in entire population under 0.5%

<http://www.foodallergy.org/document.doc?id=194>

Waserman S & Watson W. *Allergy Asthma Clin Immunol.* 2011;7 Suppl 1:S7; Sicherer & Sampson, 2010; Chafen et al, *JAMA.* 2010;303:1848-56.

Wheat: One of the Big 8 Allergens

- A classic allergy to one of the proteins, usually some of the seed storage proteins – the prolamin and closely related glutelins of wheat
- Amylase Trypsin Inhibitors (ATIs) – proteins act as natural pesticides in wheat¹
 - Reactions may be beyond gluten
 - May be some enzyme inhibitors

¹ http://www.celiaccentral.org/ceeliac-disease-research-news/researchers-believe-pest-resistance-molecules-in-wheat-play-role-in-triggering-innate-immune-responses-9146/search--Amylase_20Trypsin_20Inhibitors/

Allergy to Proteins in Wheat

27 documented wheat allergens

-Gliadins: most severe

- γ -gliadin
- ω -5 gliadin - Wheat dependent exercise induced anaphylaxis (WDEIA)

- Glutenins (wheat glutelin)

- most frequent

- α -amylase/trypsin inhibitor (ATI)

baker's asthma

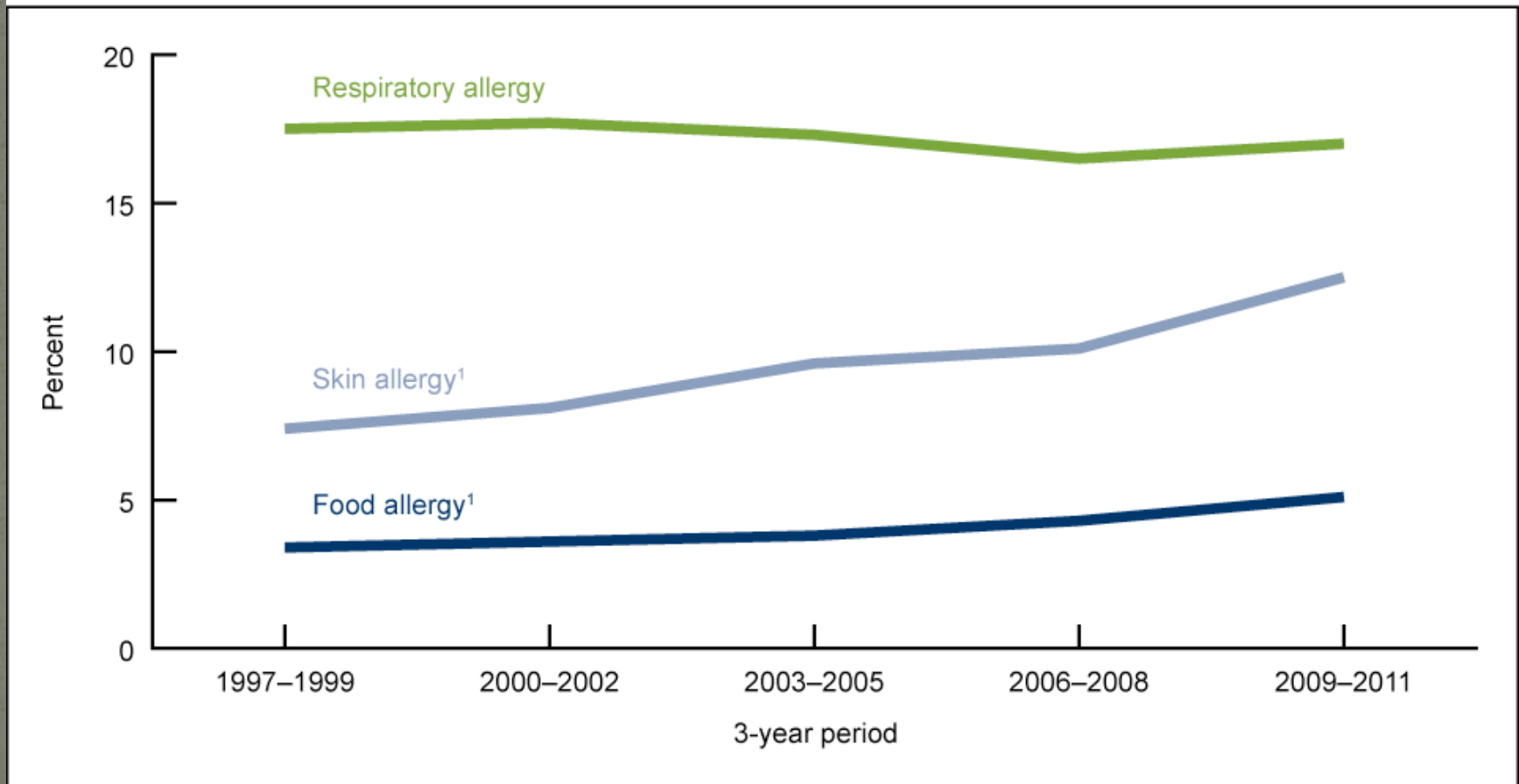
- Varies by variety

- Some exclusively caused by hydrolyzed wheat proteins or deamidated glutens

Have you eaten any wheat lately?

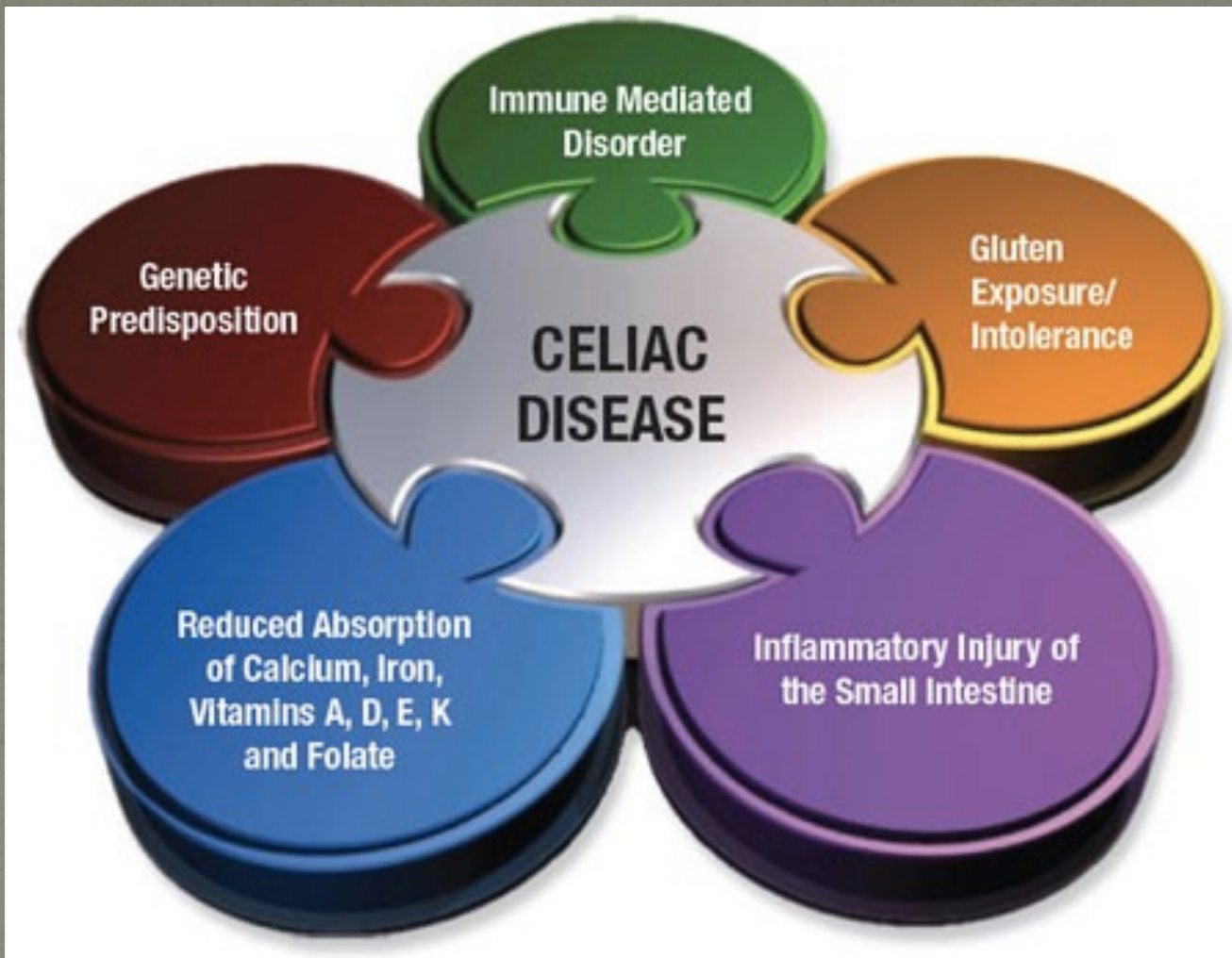
Allergies Are Increasing – US CDC data

1997–2011



¹Significant increasing linear trend for food and skin allergy from 1997–1999 to 2009–2011

Jackson KD, et al NCHS data brief, no 121. Hyattsville, MD: National Center for Health Statistics. 2013.
Dhondalay GK et al J Allergy Clin Immunol. 2018;141:20-29.



Health Canada

<https://www.canada.ca/en/health-canada/services/food-nutrition/reports-publications/food-safety/celiac-disease-gluten-connection-1.html>

Prevalence of Food Allergy

Number who say they have food allergy

35%

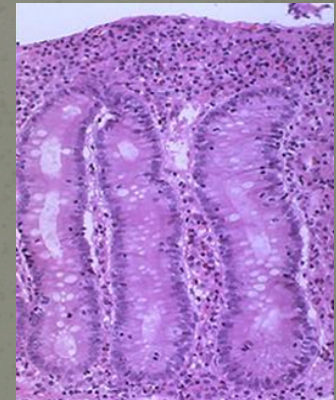
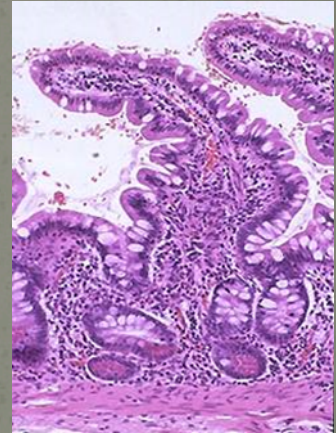
Number confirmed by oral food challenge

3.5%-5%

Acker et al J Allergy Clin Immunol. 2017;140:1587-1591. Venkataraman D, et al Clin Exp Allergy. 2018 Jan 8. doi: 10.1111/cea.13088. [Epub ahead of print]

Celiac Disease – What is it?

- Abnormal immune response in genetically susceptible individuals
 - Life-long inflammatory autoimmune disease
- Adverse response to gluten proteins
- Flattens the intestinal villa – impairing absorption
 - An autoimmune disease, not a food allergy
 - Affects the entire body
 - Associated with hundreds of signs, symptoms and related conditions



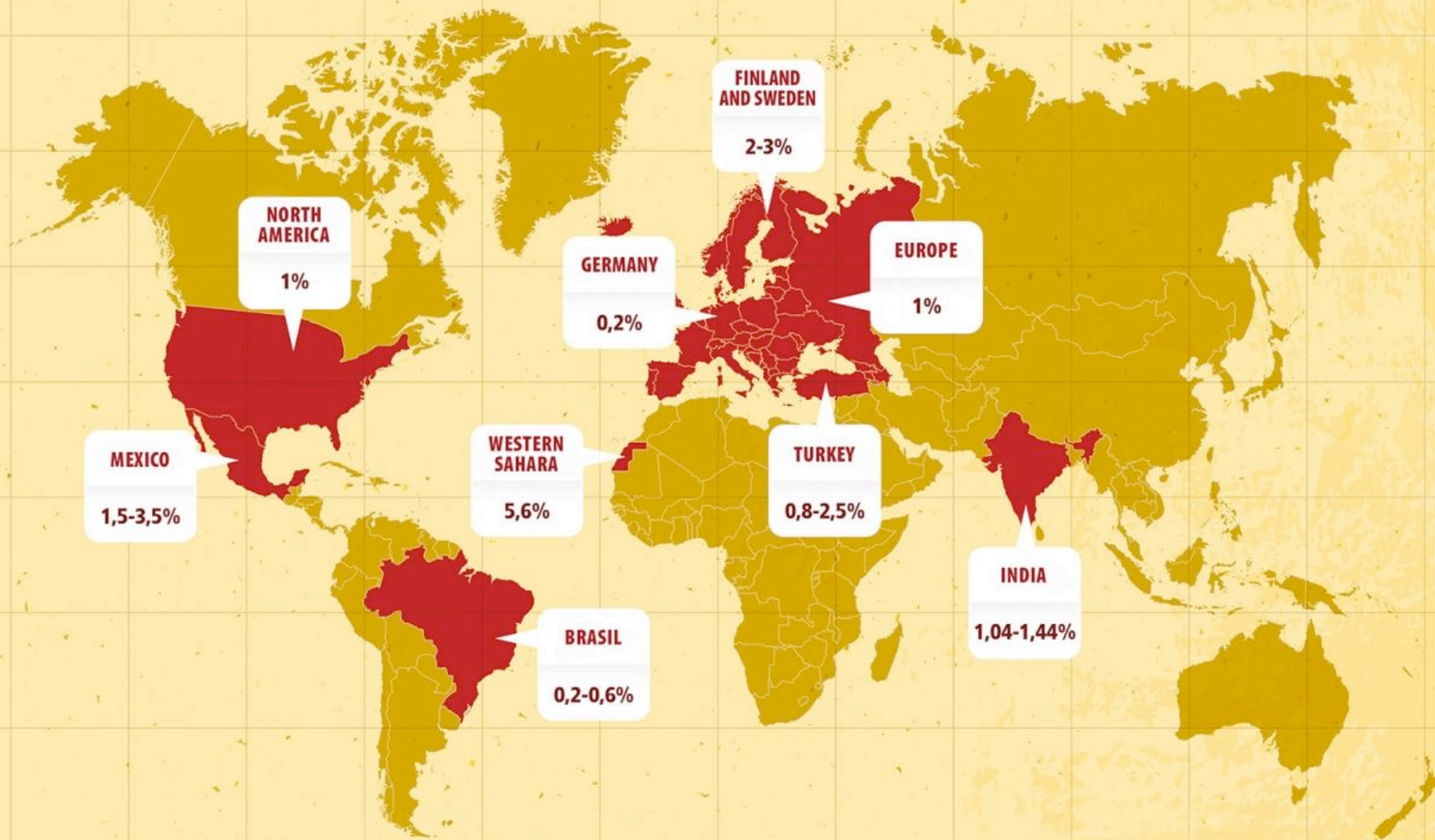
Buysschaert M. Coeliac disease in patients with type 1 diabetes mellitus and autoimmune thyroid disorders. Acta Gastroenterol Belg. 2003;66:237-40

Celiac Disease Trifecta

For celiac disease onset

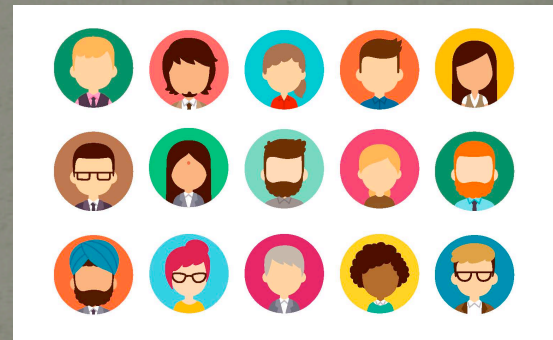
- Gluten in the diet
- Carrier of HLA-DQ2 gene
 - 90-95% of people with celiac disease
 - HLA-DQ8, other variants
 - ~5% of people with celiac disease
- Stressor/ Trigger
- Intestinal permeability
 - Emerging factor

Fasano, A. (2009, August). Celiac Disease Insights: Clues to Solving Autoimmunity. Scientific American.



Celiac Disease Incidence

- 1% (1/133) Australian, US, Western Europe
 - Global impact and varies by race and ethnicity – must carry the gene
- Runs in families:
 - 1st-degree relatives : 1 in 22
 - 2nd-degree relatives: 1 in 39
- Those with gut symptoms: 1 in 56
 - Common GI symptoms include diarrhea, constipation, bloating, malabsorption



Fasano, A. (2005) www.uchospitals.edu/pdf/uch_007937.pdf^f

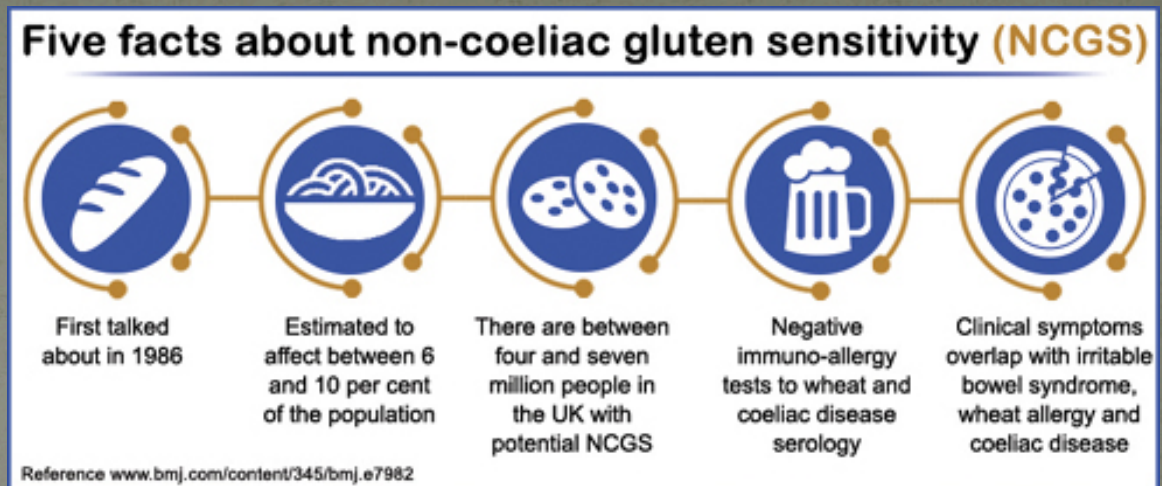
Emerging Research

- **Under diagnosed**
 - Need for accurate diagnoses
 - Cannot rely on self-diagnosis
- Prevalence is increasing
 - 2-4X more



Alberto Rubio-Tapia, Amer J Gastro, 2012; DOI: 10.1038/ajg.2012.219; Fasano, A. et al., (2003). Arch. Int Med, 163, 286-292. Image ICDS 2013

Non-Celiac Gluten Sensitivity



- Many symptoms of celiac disease
- Little is known about this relatively new condition
- Cause & unknown prevalence unknown
 - May be 6% of general population
- Exclusionary diagnosis - Not celiac disease or wheat allergy
- Scientifically validated tests -non existent
- Long-term implications are unknown

Why is Celiac Disease, and Other Autoimmune Disorders, on the Rise?

Theories about Increase Gluten Disorders

- Autoimmune diseases overall
 - Clean theory or hygiene hypothesis
- Awareness, better diagnostics
 - Under-diagnosed medically
- Foodborne infections
 - Trigger autoimmune diseases



Fumagalli et al. J Exp Med. 2009;206:1395-408; Brooks et al Curr Opin Allergy Clin Immunol. 2013;13:70-7; Frei et al Allergy. 2012;67:451-61; Laci Penagos. Nestle Nutr Workshop Ser Pediatr Program. 2011;68:169-83.

Theories about Increase Gluten Disorders

- Short fermentations
 - Gluten difficult to digest
 - Poor biological value
- Vital wheat gluten - 3X
 - Whole grain breads – added gluten
- Agronomic practices?
 - Fertilizers, growing conditions, specific varieties



Theories about Increase in Gluten Disorders

- Caesarean births
- Less breastfeeding
 - EBR probable – breastfeeding helps protect against IBD, celiac disease, and diabetes (type 1 and 2); ? allergy
- Infant feeding practices - controversial
 - No impact

Silva et al. Acta Médica Portuguesa, 2011; 24 Suppl 4:1035-40. "Diversification in the first year of food life."; Laci and Penagos. Nestle Nutr Workshop Ser Pediatr Program. 2011;68:169-83 Chmielewska A et al J Paediatr Child Health. 2017;53:889-896; Chmielewska et al . Ann Nutr Metab. 2015;67 Suppl 2:43-50; Hörnell A, et al Food Nutr Res. 2013;57; Norris et al JAMA. 2003;290:1713

Theories about Increase Gluten Disorders

- Poor diets overall; Too many calories
 - Low fiber
 - Low food variety
 - Low folate, K and other vitamins
 - High salt intake
- Antibiotic overuse by all sectors
- Medications – prescription & over-the-counter
 - Aging population
- Bacterial overgrowth, less diversity → Change in gut microbiome → disease

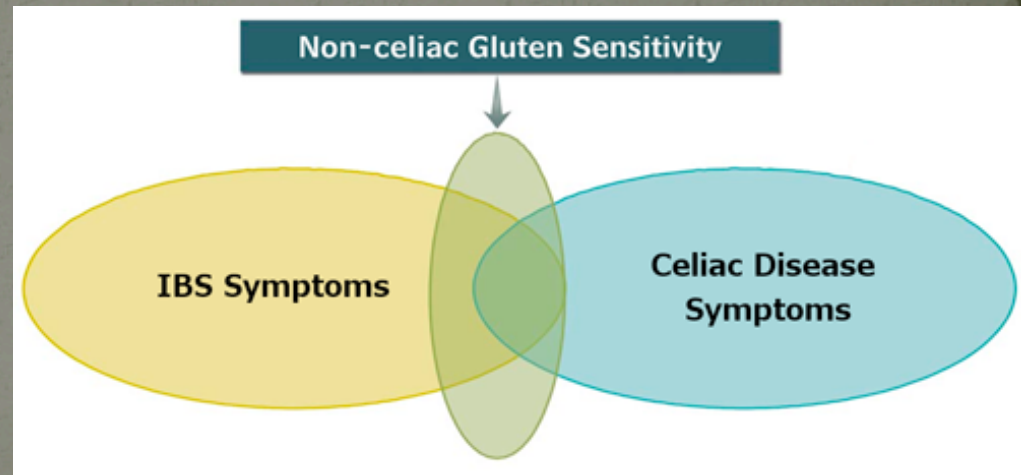


Wu et al., Nature, doi:10.1038/nature11984, 2013; Kleiweietfeld M. Nature, doi:10.1038/nature11868, 2013; Yosef N et al., Nature, doi:10.1038/nature11981, 2013. Ceseviciene 2012; Grove 2009; Katz 2011, Rizzello 2007; Belz 2012

Non-Celiac Gluten Sensitivity Symptoms

- 68% Abdominal pain
 - Gas, bloating (IBS)
- 40% Eczema / rash
- 35% Headache
- 34% “Foggy mind”
- 33% Fatigue
- 33% Diarrhea
- 22% Depression
- 20% Numbness extremities
- 11% Joint pain

Non-specific
Relate to a number of conditions
No distinct diagnostic measures



*Center for Celiac Research in Baltimore- Dr. Alessio Fasano
2004-2010; 347/5896 patients- 6% fulfilled criteria for GS*

NCGS and Amylase-Trypsin Inhibitors

- ATIs -Potential activator of innate immunity in NCGS
 - Intervention studies are needed

Wheat proteins							
Gliadins (40%)				Glutenins (40%)		Albumin (10%)	
α	β	χ	ω	HMW	LMW		
Gluten				ATI's			
<ul style="list-style-type: none"> • Auto-immune response in coeliac disease • Increased gut permeability in everyone • NEW: Gliadin transported to pancreas in healthy and diabetic mice 				<ul style="list-style-type: none"> • Innate immune activation in coeliac and NCGS • NEW: modern wheat strains have higher levels of ATIs 		<ul style="list-style-type: none"> • Involved in pathogenesis of type 1 diabetes • NEW: some globulins can stimulate coeliac immune reaction 	

Reig-Otero Med Food. 2018 Jan 9.

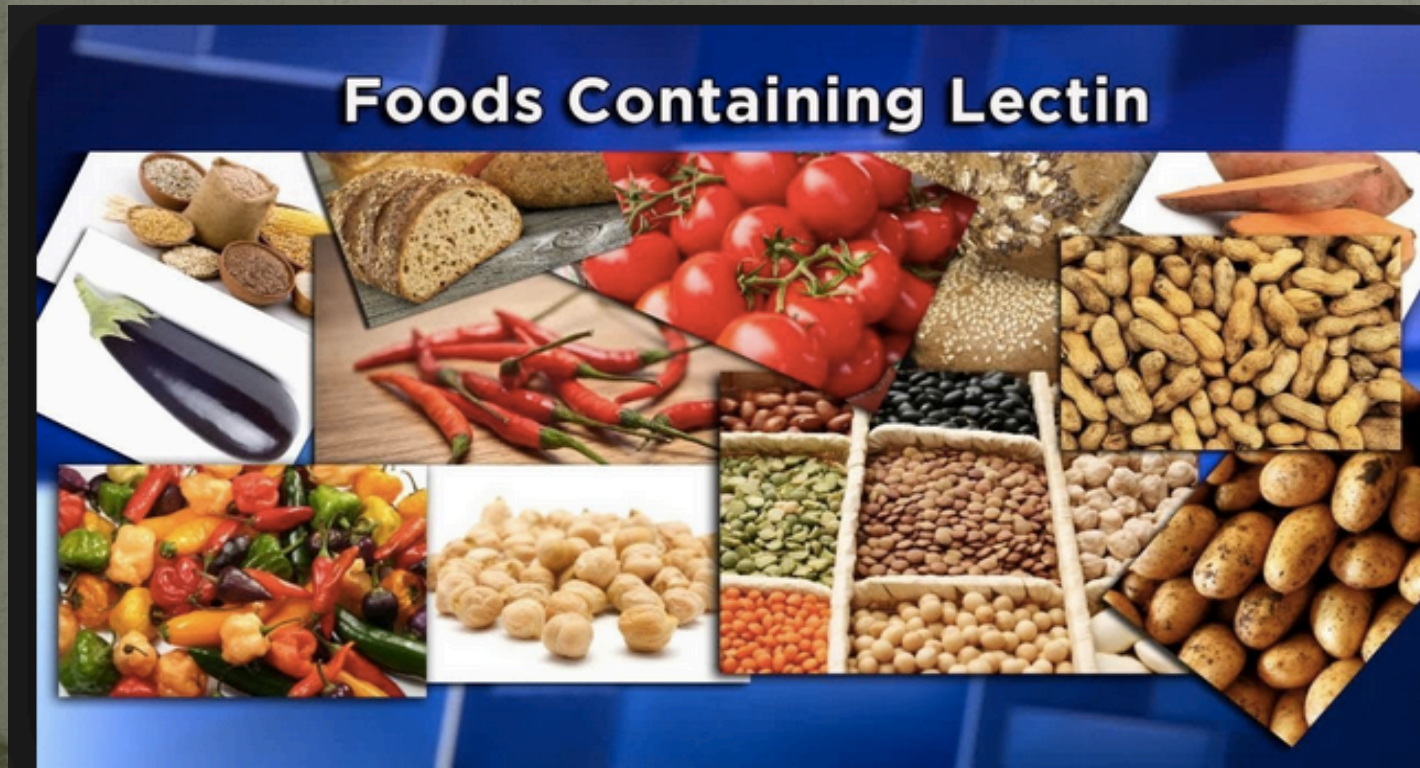
What is the Casual Agent?



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5707740/figure/nutrients-09-01268-f001/>

Lectins and Antioxidants

- Lectins are purported to increase inflammation
 - Heat, soaking, cooking reduce them
- Phenolics reduce inflammation
 - Many studies show these counter effects of lectins



Van Hung P. Crit
Rev Food Sci Nutr.
2016 56:25-35;
Brouns J. Cer. Sci.
2013; 58 :209e215

Wheat Lectin – Wheat Germ Agglutinin

Wheat Derived Products	WGA $\mu\text{g/g}$ ($\pm\text{SD}$)	Reference Source
Wheat germ	300 (± 35)	<i>Vincenzi et al., 2000</i> [42]
Wheat germ	100–500	<i>Peumans and Van Damme, 1996</i> [39]
Semolina ^a	4.0 (± 1.0)–10.7 (± 1.5)	<i>Matucci et al., 2004</i> [43]
Flour ^a	4.3 (± 0.7)–4.4 (± 1.0)	
Wholemeal flour ^a	29.5 (± 2.5)–50 (± 5.5)	
Pasta ^a	≤ 0.4 (± 0.2)–3.2 (± 0.2)	
Pasta cooked ^a	≤ 0.3 (± 0.2)	
Wholemeal pasta (enriched with wheat germ)	40 (± 2.7)	
Wholemeal pasta (enriched with wheat germ) cooked	Not detectable	
Wholemeal pasta ^a	0–5.7 (± 0.2)	
Wholemeal pasta cooked ^a	Not detectable	
Breakfast cereals ^a	13–53	<i>Ortega-Barria et al., 1994</i> [41]

Celiac & Schizophrenia

- 7,997 Danes
 - Rate of celiac 1.5/ 1000 schizophrenics
- Small subset of schizophrenics
 - Consumption of gluten can exacerbate
 - No one dietary intervention – many strategies
- Limited data
 - Observational
 - Case-reports
 - Mixed results

Arroll et al Nutr. J. 2014; 13:1; Dickerson et al Biol Psychiatry 2010; 68:100-4; BMJ. 2004;328(7446):1017; Jackson et al Schizophr Res 2014; 159:539-42

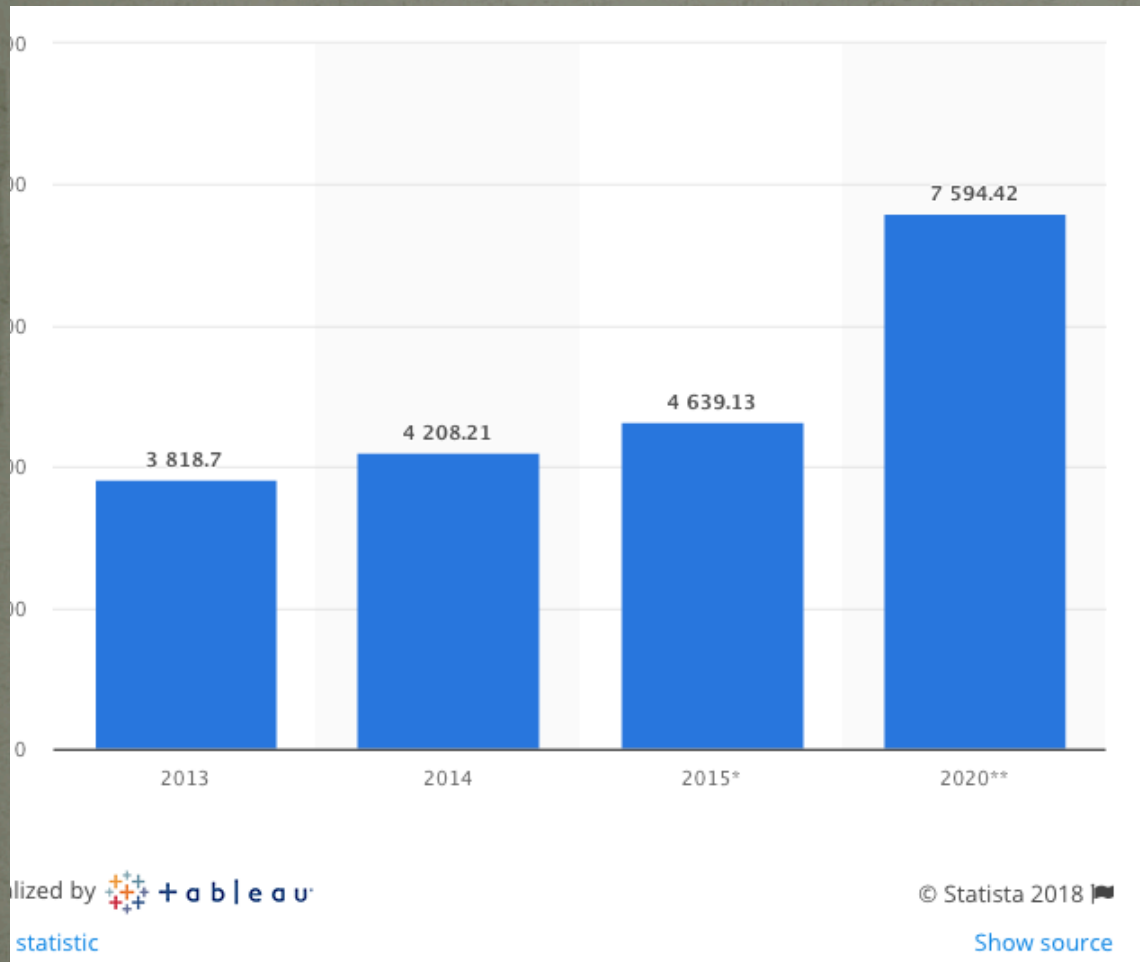
Celiac Disease and Attention-Deficit Hyperactivity Disorder (ADHD)

- Epi
 - Low vs High adherence to Mediterranean diet
 - Risk of ADHD n=60/60 RR=7.07
- Intervention - 362 patients 5 – 15 yrs, ~400 controls
 - Gluten-free diet - no measurable improvement
- Antibody response - ns
 - ADHD 1.1% controls 0.8%
- Biopsy -suggestive of CD in 1 ADHD (0.27%).

F ERMENTABLE
O LIGOSACCHARIDES
D ISACCHARIDES
M ONOSACCHARIDES
A ND
P OLYOLS

Cause gas

Global Gluten-Free Market (Billions US\$)

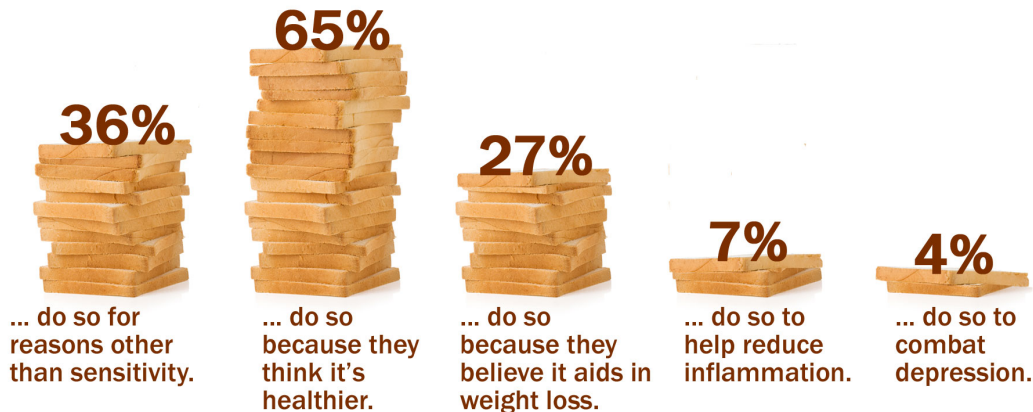


Top Reasons for Seeking GF Products

BREAKING up with BREAD

With sales estimated to reach \$10.5 billion in 2013, the gluten-free food and beverage market is benefiting from consumers who choose wheat-free products for reasons other than sensitivity, according to Mintel.

Of those who eat gluten-free foods...



SOURCE: MINTEL | FOODBUSINESSNEWS.NET

https://www.glutenfreemg.com/info/GFMG_GFConsumers.pdf
Hartman Group Survey, 1700 US Adults, July 2009

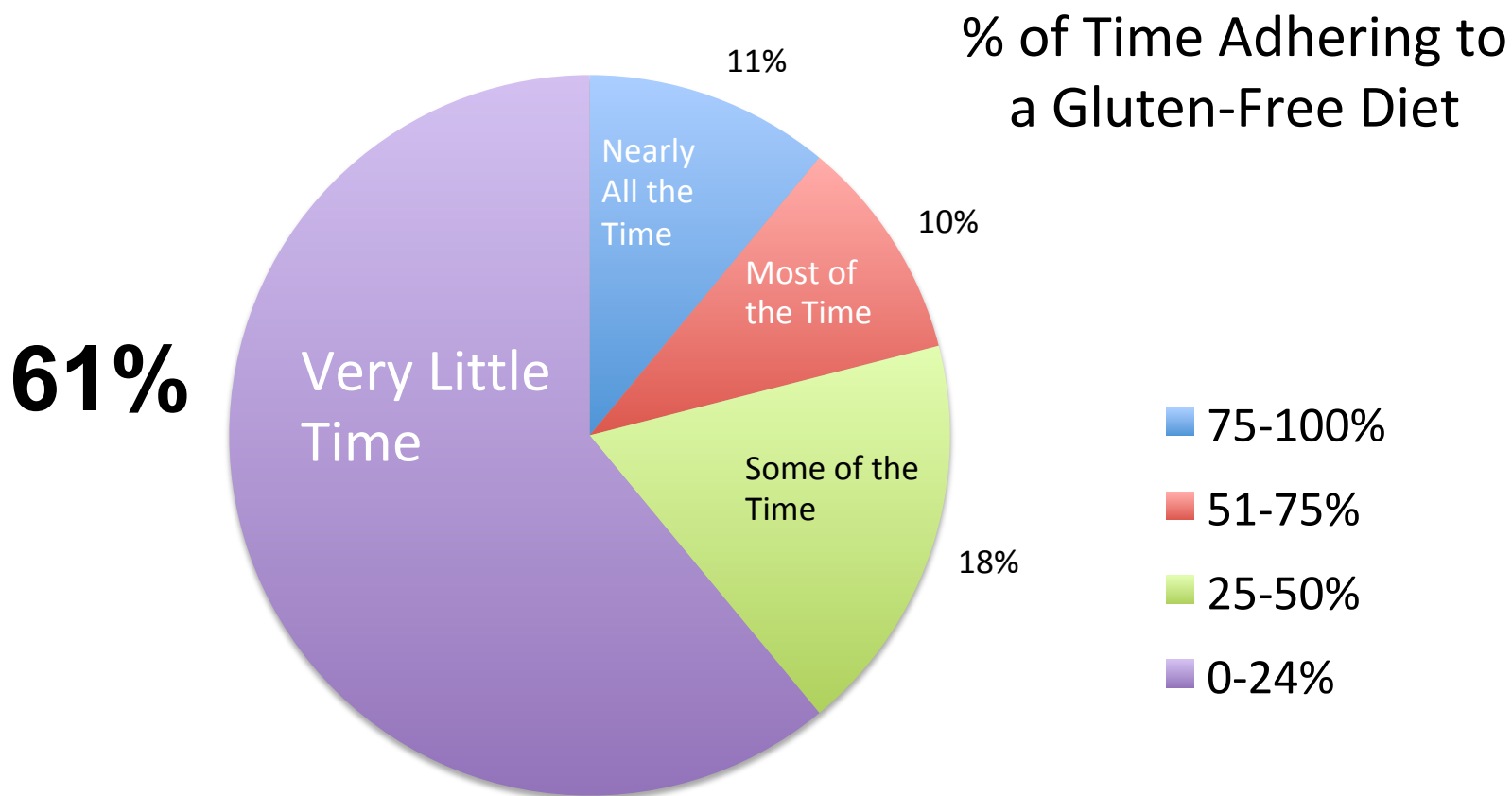
1. Digestive Health (39%)
2. Nutritional Value (33%)
3. Healthier Skin (20%)
4. Joint Pain (18%)
5. Improve Concentration (13%)
6. Alleviate Stress (12%)
7. Cleansing Regimen (10%)
8. Alleviate Depression (9%)
9. Alleviate
10. Asthma (6%)
10. Treat Celiac Disease (5%)

Prediction - 10% of wheat products will be GF in 2020

Gluten-Free (GF) Trends

- >15% - GF products are part of a healthy lifestyle
 - Perceived as healthier
- GF foods & labeling
 - Improved in taste, availability
 - More ancient grains, such as quinoa and amaranth
 - Increases nutrition
 - Enhances flavor and interest

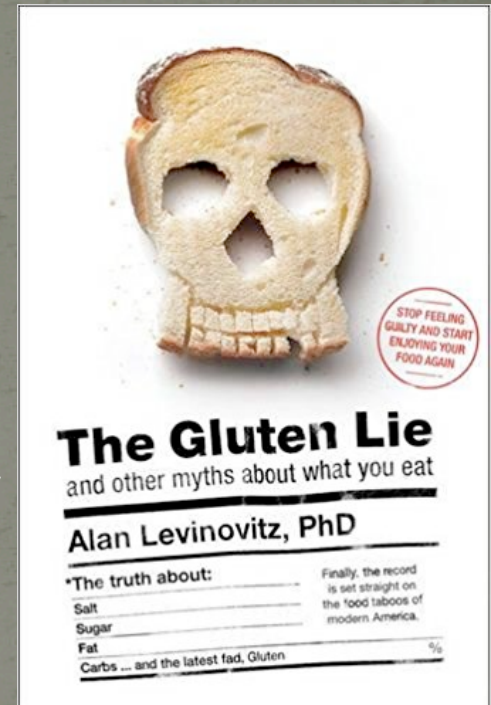
Gluten-Free: A Matter of Degree



Source: Hartman Group Survey, 1700 US Adults, July 2009

Conclusions

- We did evolve to eat grain
- Autoimmune diseases including celiac are on the rise
- Celiac is under-diagnosed and over-self diagnosed
- Gluten free options are improving but still lack some important components
- Most charges about gluten are simply charges
- Lectins – problems with raw grains
- Fodmaps, ATIs - more data are needed





Fibromialgianoticias.com2017