

Webinar Will Begin Momentarily

TODAY'S AGENDA:

- Welcome
- Speaker Introduction
- Presentation
- Q&A
- Closing

Precision Nutrition - Genetics of Food Intolerances and Sensitivities



WEBINAR HOST:

Keith Hine, MS, RD

VP of Healthcare, Sports & Professional Education
Orgain, LLC



WEBINAR PRESENTER:

Dr. Ahmed El-Sohemy, PhD

Professor and Associate Chair at the University of Toronto

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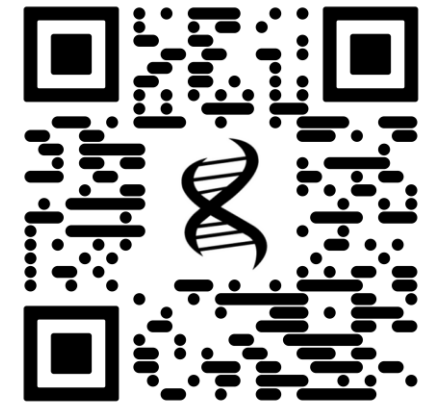
Precision Nutrition

Recent Advances and Controversies in Genetic Testing

Webinar Series



Release date: Jan 23, 2025



Disclosures

A.E-S. is the Founder and holds shares in Nutrigenomix Inc.

Overview

Gluten Intolerance

Lactose Intolerance

Histamine Intolerance

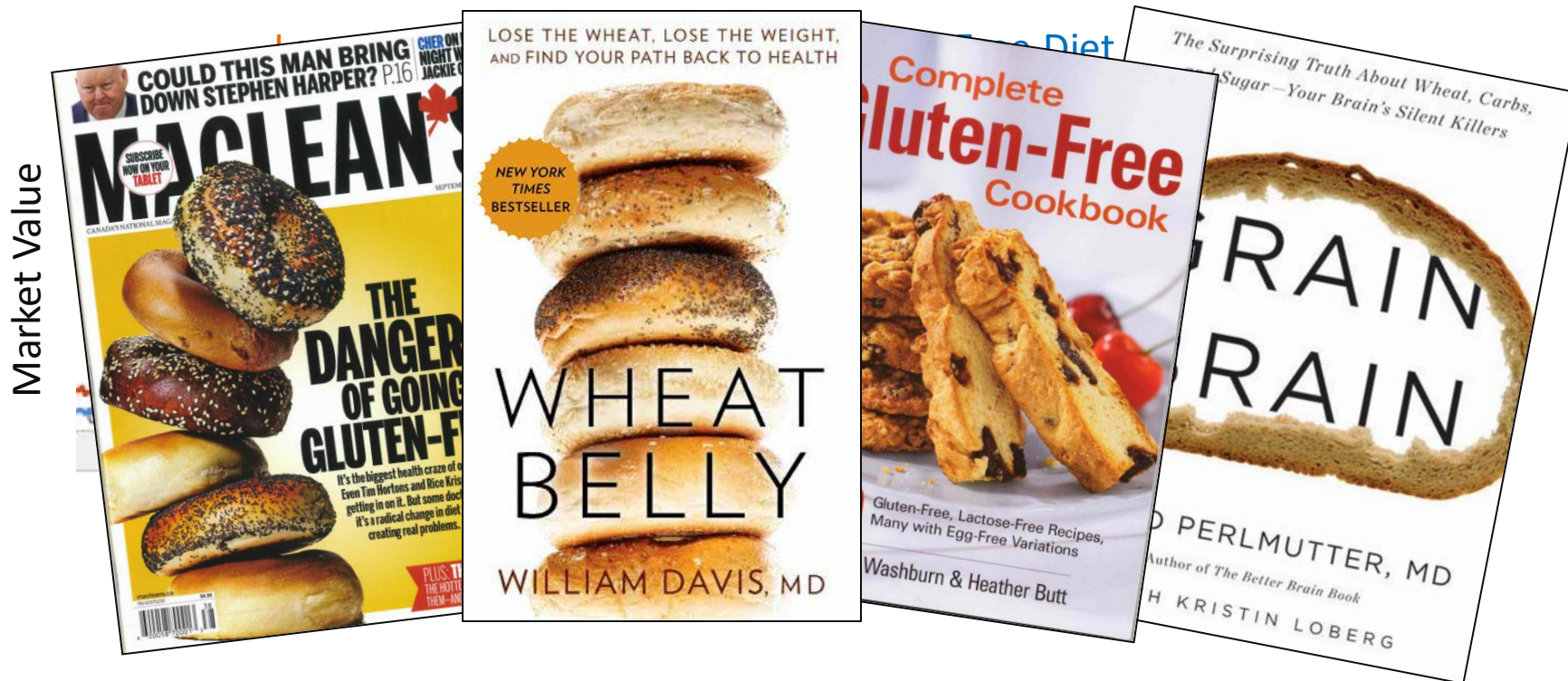
Other Food Sensitivities

Gluten Intolerance

Gluten

- Gluten-free diet increasing in popularity
- Gluten-free market valued at \$4.2 billion

Maclean's Magazine, 2013



Celiac Disease

- Dr. Willem-Karel Dicke
- Observed link between wheat (gluten) and symptoms of celiac disease
- Pioneered the gluten-free diet



HOW CELIAC DISEASE AFFECTS YOUR BODY



Celiac disease decreases productivity

Patients report missing an average of 5 work/school weeks a year due to gluten exposure



Celiac disease is genetic

People with a first degree relative with celiac have a 1 in 10 risk of developing the disease



Things You May Not Know About Celiac Disease

Celiac disease isn't rare

1 in 100 people have celiac disease. This is nearly 80 million people worldwide.

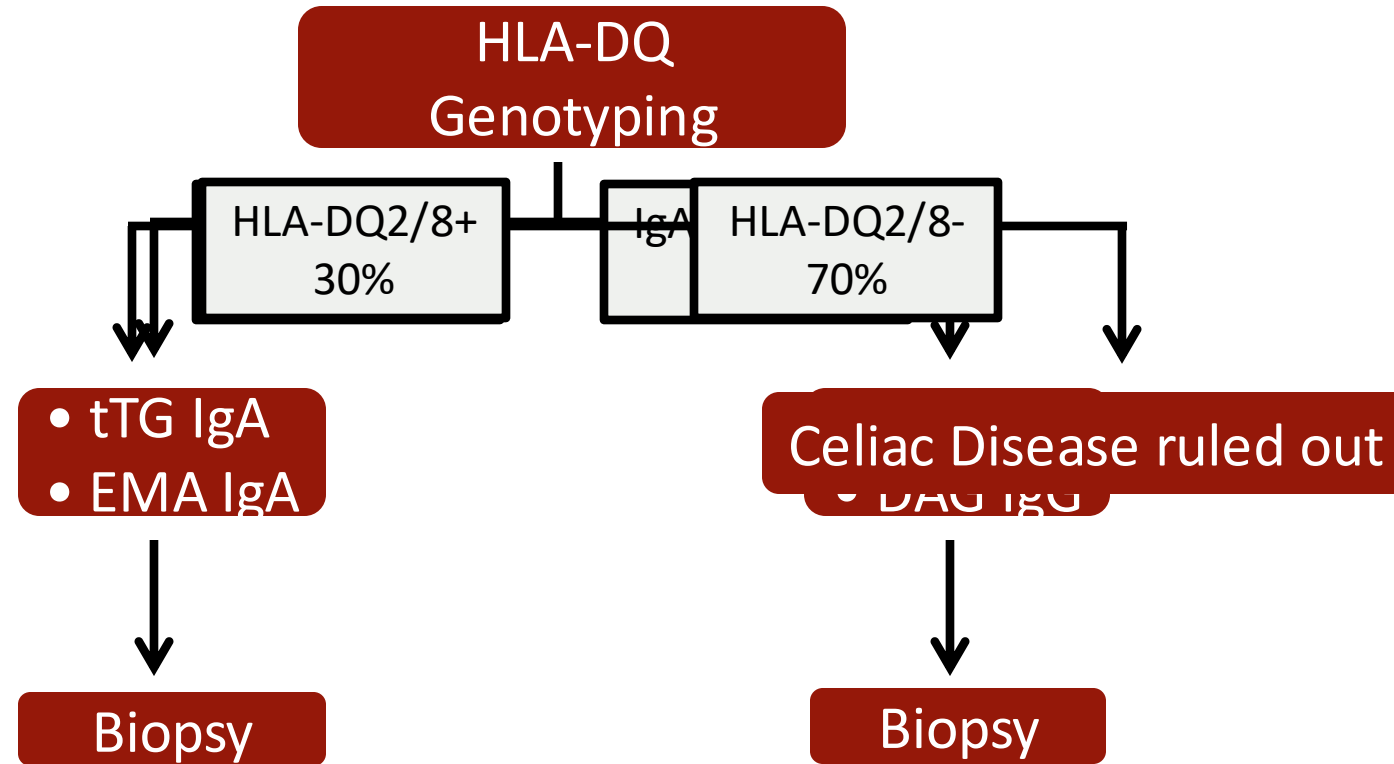


Gluten-free is not optional for people with celiac disease

A strict, gluten-free diet is the only treatment for celiac disease

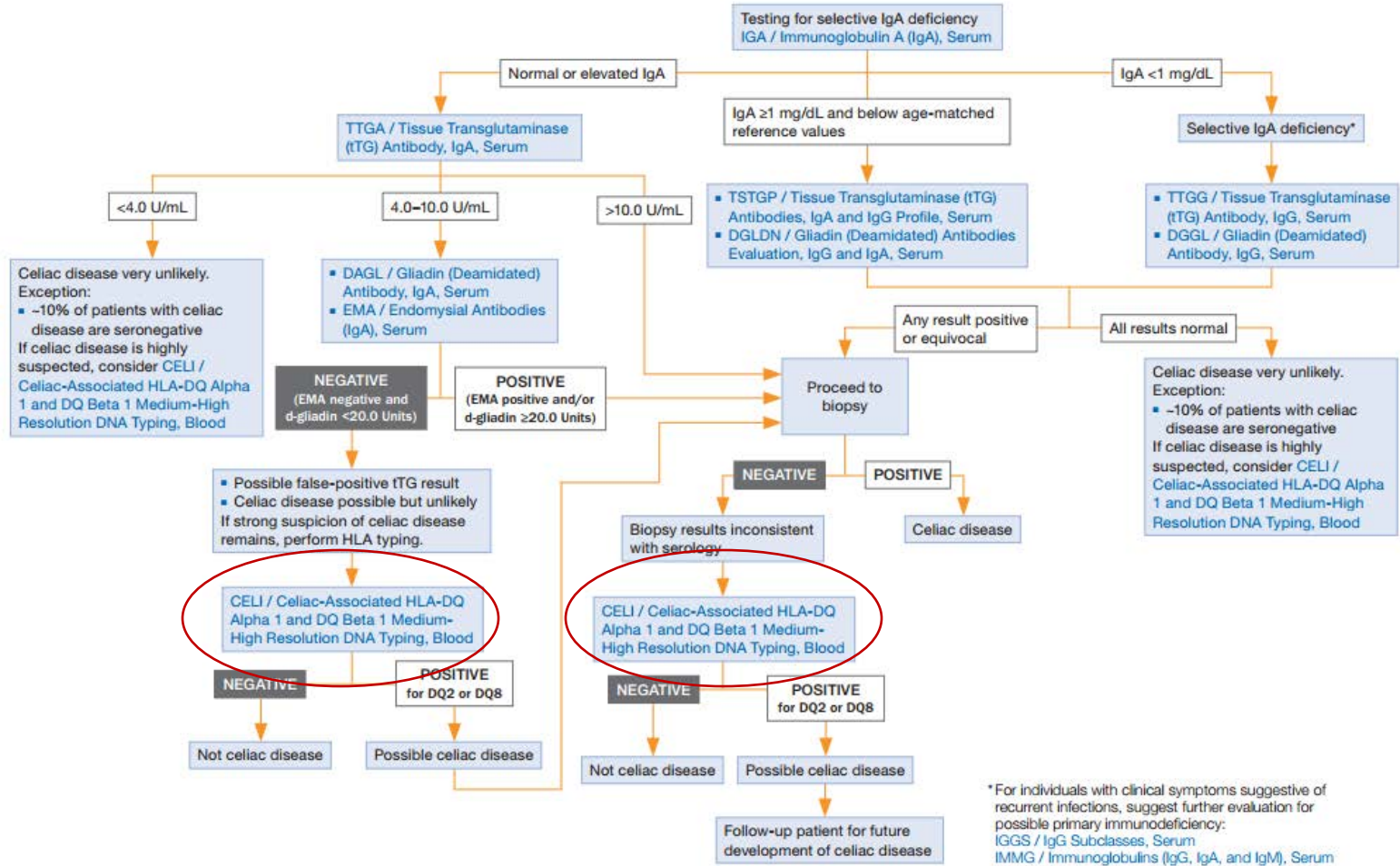


Diagnostic Approach



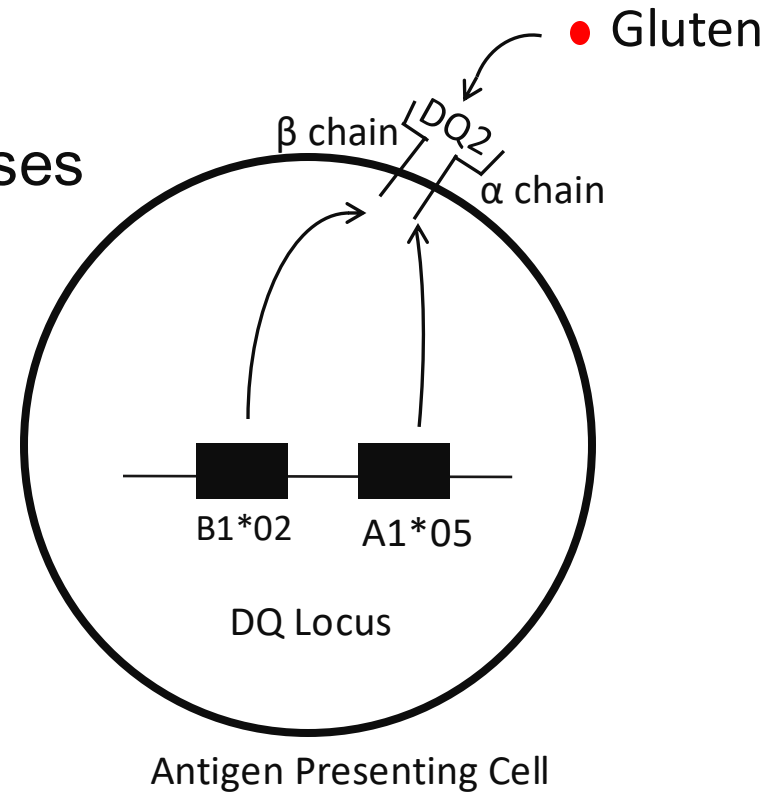
tTG = Tissue transglutaminase
EMA = Endomysial antibody
DAG = deamidated antigliadin

Diagnostic Approach



Human Leukocyte Antigen

- MHC region on chromosome 6
- Role in susceptibility to various autoimmune and inflammatory diseases
- MHC Class II: DQ locus
- Heterodimers DQ2 or DQ8 (sometimes DQ7) necessary for the development of celiac disease



ORIGINAL ARTICLE

Risk of Pediatric Celiac Disease According to HLA Haplotype and Country

Edwin Liu, M.D., Hye-Seung Lee, Ph.D., Carin A. Aronsson, M.Sc.,
William A. Hagopian, M.D., Ph.D., Sibylle Koletzko, M.D., Ph.D.,
Marian J. Rewers, M.D., M.P.H., George S. Eisenbarth, M.D., Ph.D.,*
Polly J. Bingley, M.D., Ezio Bonifacio, Ph.D., Ville Simell, M.Sc.,
Daniel Agardh, M.D., Ph.D., for the TEDDY Study Group†

N Engl J Med 2014;371:42-9.
DOI: 10.1056/NEJMoa1313977

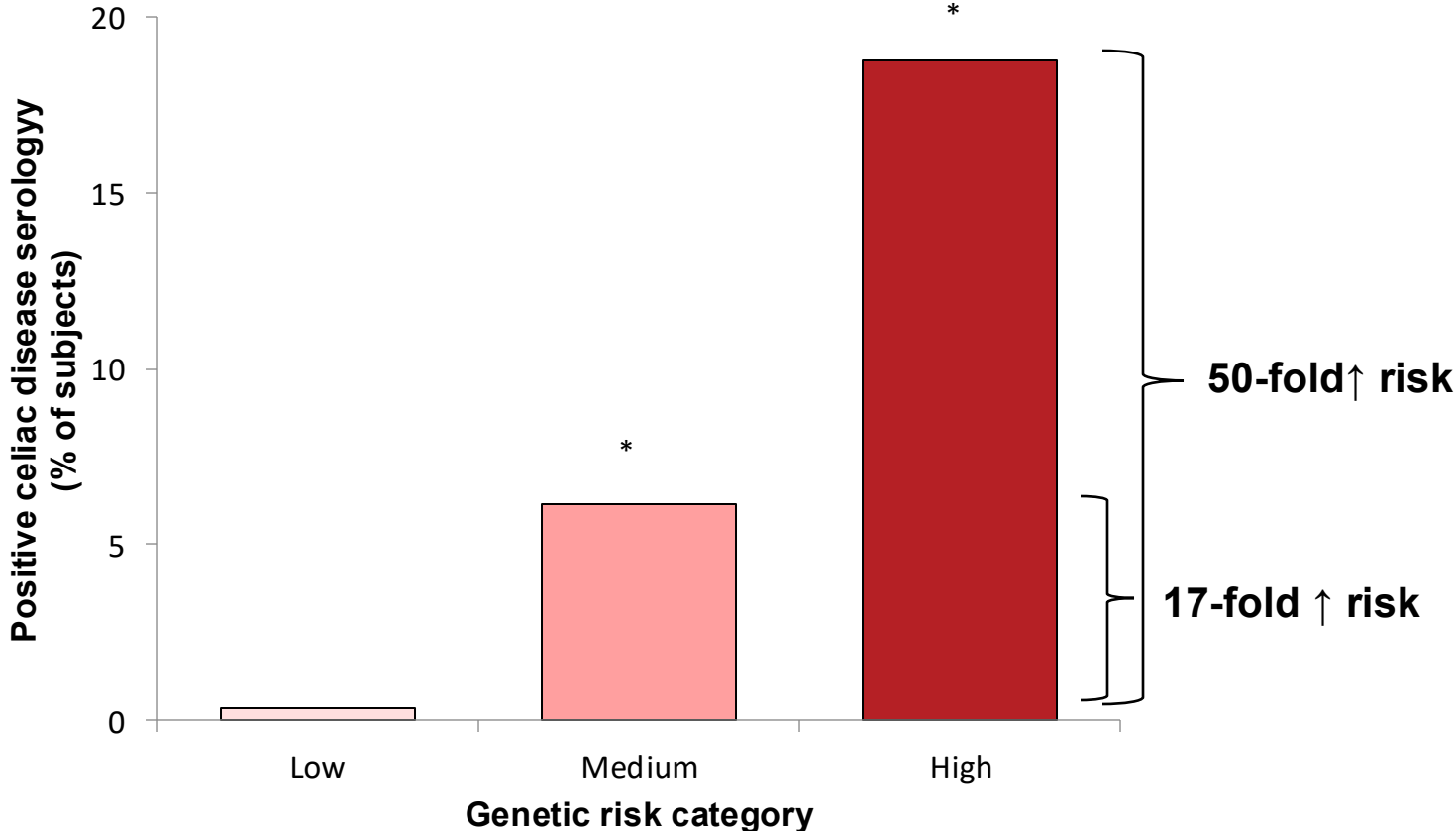
Results

- Assessed the development of celiac disease tTG antibodies in 6,403 children with *HLA* risk genotypes from:
 - United States
 - Germany
 - Finland
 - Sweden
- 16% of children at “high risk” and 6% at “medium risk” developed tTG antibodies ($p < 0.001$)
- Sweden = $\sim \uparrow 2$ x risk of developing tTG antibodies compared to United States ($p < 0.001$)
 - Suggests environmental factors (eg. timing of first gluten exposure and breastfeeding)

Stratifying Risk for Celiac Disease in a Large At-Risk United States Population by Using HLA Alleles

MICHELLE M. PIETZAK,* TIMOTHY C. SCHOFIELD,‡ MATTHEW J. MCGINNISS,‡ and ROBERT M. NAKAMURA‡

CLINICAL GASTROENTEROLOGY AND HEPATOLOGY 2009;7:966-971



2017

Open Access

Research

BMJ Open Prevalence of positive coeliac disease serology and HLA risk genotypes in a multiethnic population of adults in Canada: a cross-sectional study

Joseph Jamnik,¹ Christopher R Villa,¹ Sirbarinder Bryn Dhir,¹ David J A Jenkins,^{1,2}
Ahmed El-Sohemy¹

Jamnik J, et al. *BMJ Open* 2017;**7**:e017678. doi:10.1136/bmjopen-2017-017678

Assessed prevalence of CD across ethnic groups, using HLA genotyping followed by CD serology (anti-tTG antibodies)

1. Elevated-risk HLA genotypes (ie medium or high): ~35% of participants
 - Prevalence highest in Caucasians and lowest in East Asians
2. CD-positive serology: ~1% of participants
 - Prevalence, again, highest in Caucasians
3. Of that 1%, nearly 90% were undiagnosed!



Majority of Torontonians with celiac disease don't know they have it, study shows

About 1 per cent of Torontonians are estimated to have celiac disease, an autoimmune disorder triggered by gluten. Yet University of Toronto researchers found that 87 per cent of people living with celiac in Toronto aren't aware they have the condition.



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Celiac disease goes undiagnosed in 90% of cases, Canadian researchers find

Detection complicated by popularity of gluten-free diet among many who don't have illness

CBC News Posted: Oct 06, 2017 1:48 PM ET | Last Updated: Oct 06, 2017 3:34 PM ET



Researcher Ahmed El-Sohehy was surprised to find how many cases of celiac disease go undiagnosed given that gluten-free diets started becoming popular over a decade ago. (Marcy Markusa)

2300 shares



Celiac disease is common but mostly goes undiagnosed, say Canadian nutrition researchers who studied the blood work of nearly 3,000 people.

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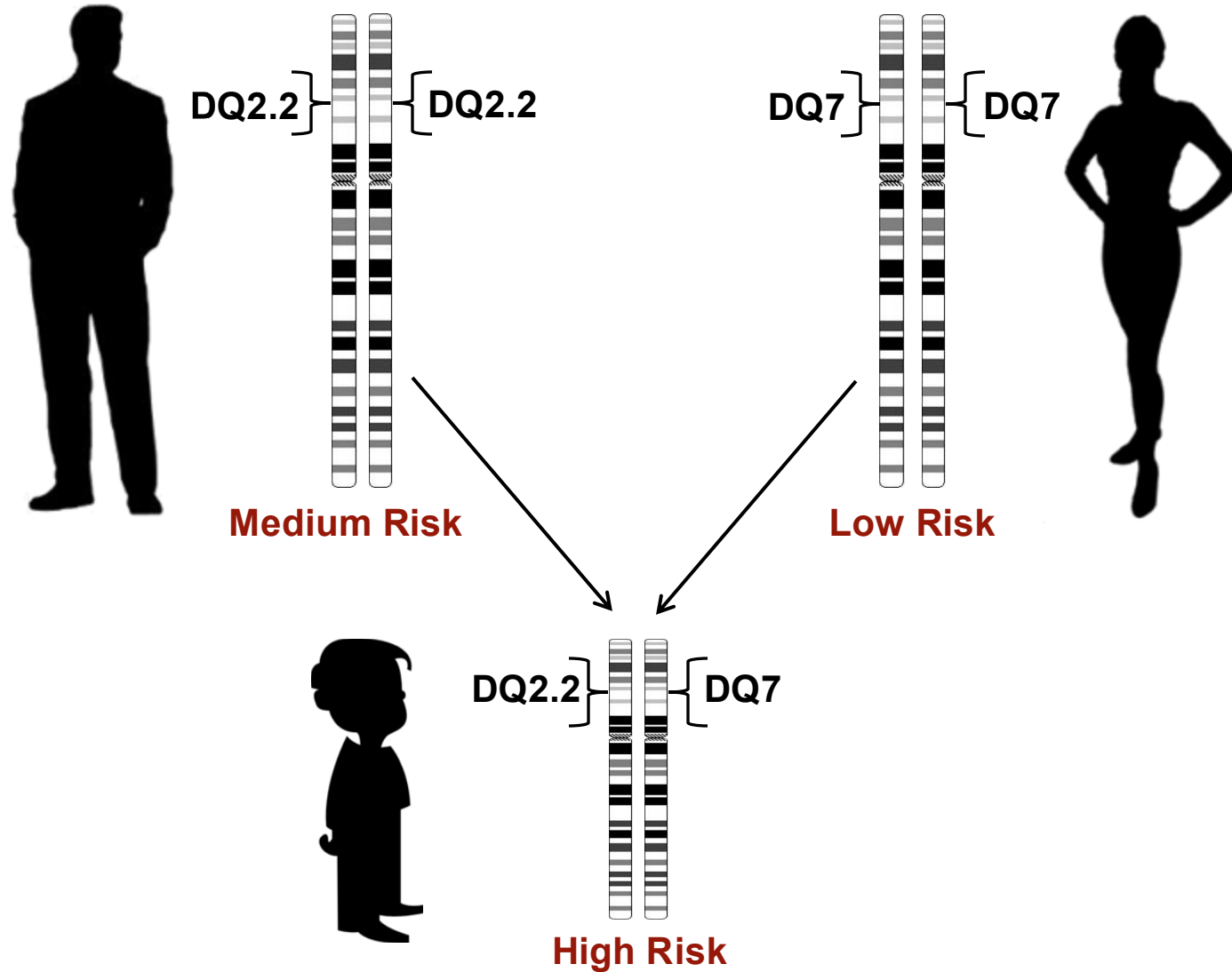
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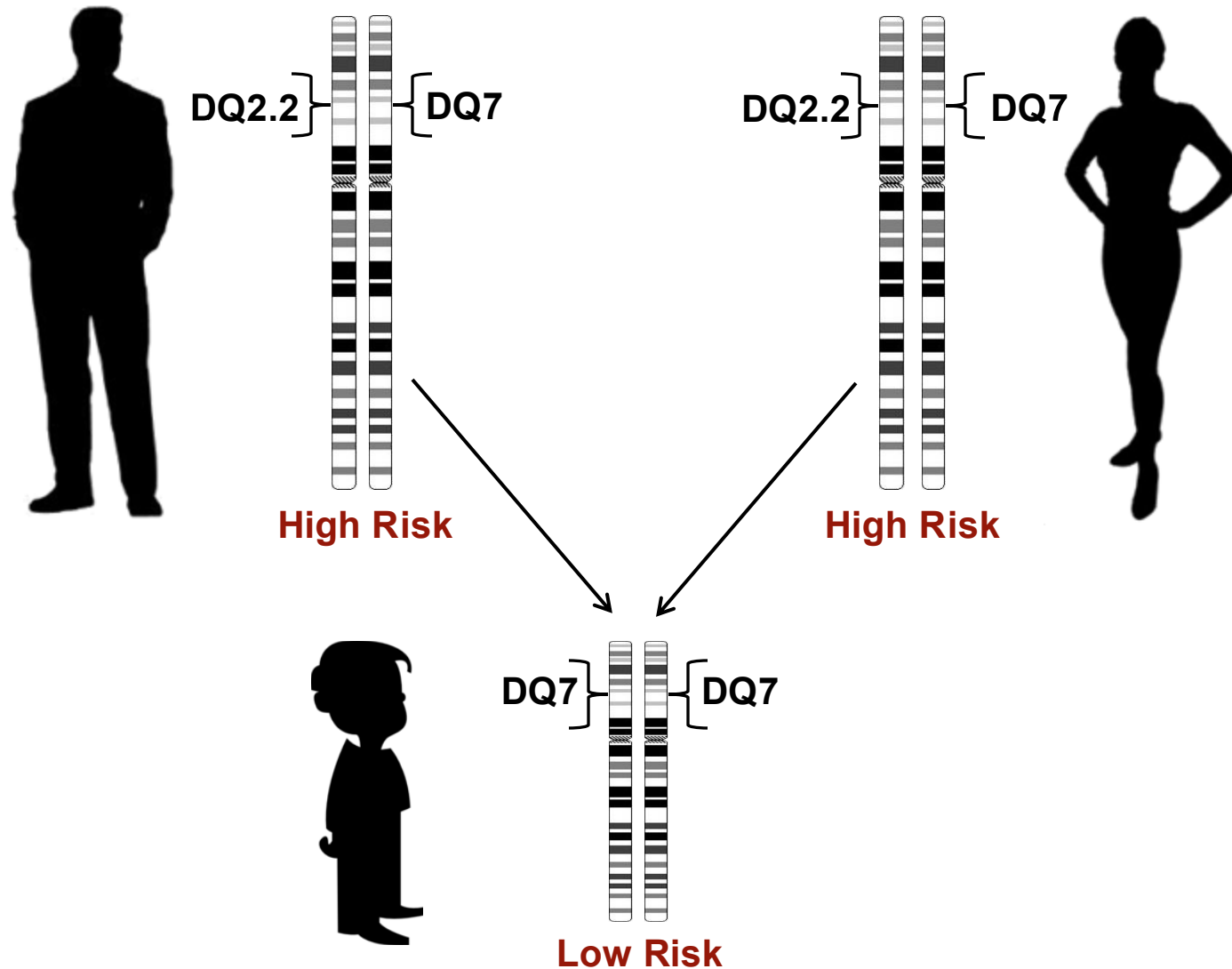
Play Smart



Parents Risk \neq Children's Risk: Case Study



Parents Risk \neq Children's Risk: Case Study



Case Study

From
23andMe

Celiac Disease

Celiac disease is an autoimmune condition in which the consumption of gluten (found in wheat, barley, and rye) can result in damage to the small intestine. Celiac disease can lead to both digestive and non-digestive symptoms. This test includes two common variants associated with an increased risk of developing celiac disease.

Overview

Scientific Details

Frequently Asked Questions

Based on your genetic test results, you **do not have** the two genetic variants we tested.

You are not likely at risk of developing celiac disease based on your genetic result.



0 variants detected

in the HLA-DQA1 and HLA-DQB1 genes



Gluten

Gluten is a protein found in wheat, barley, rye and products made from these grains. Some oats also contain gluten. Many foods that contain gluten provide fibre from whole grains and can be an excellent source of vitamins and minerals. However, for some people, gluten can cause severe digestive problems leading to nutrient malabsorption, anemia and many serious health problems.

Celiac Disease & Gluten Sensitivity

Celiac disease represents the most severe form of gluten intolerance and affects about 1% of the population. People with celiac disease require a gluten-free diet for life.* Non-celiac gluten sensitivity (NCGS) is a milder form of gluten intolerance that may affect 5% of the population. Individuals with NCGS often experience diarrhea, abdominal pain, fatigue and headaches when they consume gluten-containing foods. However, these adverse effects of gluten in individuals who do not have celiac disease are poorly understood and NCGS remains controversial.*

*Tonutti E and Bizzaro N. Diagnosis and classification of celiac disease and gluten sensitivity. Autoimmunity Reviews. 2014;13:472-6.

HLA

The HLA genes produce a group of proteins called the human leukocyte antigen (HLA) complex, which are responsible for how the immune system distinguishes between the body's own proteins and foreign, potentially harmful proteins. Research has shown that the HLA genes are the most important genetic predictor of gluten intolerance. Approximately 99% of people with celiac disease and 60% of those with non-celiac gluten sensitivity* have the DQ2 or DQ8 risk version of HLA, compared to only 30% of the general population. Six variations in the HLA genes can be used to classify individuals into predefined risk groups for gluten intolerance. Risk prediction is based upon a scale of low, medium or high risk.

*Mark Wolters VM and Wijmenga C. Genetic background of celiac disease and its clinical implications. American Journal of Gastroenterology. 2008;103:190-5.
Sapone A et al. Divergence of gut permeability and mucosal immune gene expression in two gluten-associated conditions: celiac disease and gluten sensitivity. BMC Medicine. 2011;9:23.
Monsieur AJ et al. Effective detection of human leukocyte antigen risk alleles in celiac disease using tag single nucleotide polymorphisms. PLoS ONE. 2008;3:e2270.



Nutrition Considerations when Following a Gluten-Free Diet

Gluten-free foods include all unprocessed vegetables, fruit, dairy products, meat, fish, poultry, nuts, legumes, seeds, fats and oils. Gluten-free grains include rice, quinoa, corn, buckwheat, amaranth, and millet. For individuals who need to follow a gluten-free diet, foods to avoid include any products that are made with wheat, rye, barley or triticale. Pure oats should be consumed in moderation if tolerated, while regular oats (which contain wheat) should be avoided. For the vast majority of the population, consuming a gluten-free diet is unnecessary. Processed gluten-free products often have more calories, sodium, added sugar and fat and fewer nutrients compared to their gluten-containing counterparts.

Sources of Gluten

Major Sources of Gluten	Hidden Sources of Gluten
Bread	Salad dressing
Pasta	Pudding
Cereal	Imitation crab meat
Crackers and chips	Vegan meat substitute
Oats*	Potato chips
Baked goods	French fries
Malt	Soup stock cubes
Soy sauce	Chocolate and candy
Gravy	Processed meat
Barley or wheat based-beer	Canned soup
Vinegars	Instant rice
Wheat - incl rye, spelt and barley	Ice cream

*Pure oats do not contain gluten; however, oats are often cross-contaminated with gluten-containing grains



Recommendation

You have a high risk for developing celiac disease; however, this does not mean you have celiac disease. Speak to a healthcare professional if you experience diarrhea, steatorrhea, cramps, flatulence, fatigue or joint pain while consuming gluten containing foods, or if you have a family member with celiac disease. Major dietary sources of gluten include bread, pasta, cereal and any baked goods made with wheat, barley or rye. It is not recommended that you immediately attempt to remove gluten from your diet, as eliminating gluten may interfere with the accuracy of celiac disease diagnostic tests.

Your Results

Gene	Markers
HLA	rs2395182 rs7775228 rs2187668 rs4639334 rs7454108 rs4713586

Risk Variants	Your Variants
Algorithm	GT CT CC AG TT AA

Your Risk

High

High risk for gluten intolerance.

RESULT VALUES

Range CU

Deamidated Gliadin Antibody IgG

Reference Range:

<20 Negative

20 - 30 Weakly Positive

>30 Positive

Tissue Transglutaminase Antibody (Ig...

Value **150**

Standard
Range CU

Tissue Transglutaminase Antibody IgA

Reference Range:

<20 Negative

20 - 30 Weakly Positive

>30 Positive

False negative results may occur in individuals who are IgA deficient.

Biopsy confirmed Celiac Disease

Non-Celiac Gluten Sensitivity

RESEARCH ARTICLE

Open Access

Divergence of gut permeability and mucosal immune gene expression in two gluten-associated conditions: celiac disease and gluten sensitivity

Anna Sapone^{1,2}, Karen M Lammers², Vincenzo Casolaro^{2,3}, Marcella Cammarota⁴, Maria Teresa Giuliano⁴, Mario De Rosa⁴, Rosita Stefanile⁵, Giuseppe Mazzarella⁵, Carlo Tolone⁶, Maria Itria Russo⁷, Pasquale Esposito⁷, Franca Ferraraccio⁸, Maria Carteni⁴, Gabriele Riegler¹, Laura de Magistris¹, Alessio Fasano^{2*}

Sapone et al. *BMC Medicine* 2011, 9:23

OPINION

Open Access

Spectrum of gluten-related disorders: consensus on new nomenclature and classification

Anna Sapone^{1,2}, Julio C Bai³, Carolina Ciacci⁴, Jernej Dolinsek⁵, Peter HR Green⁶, Marios Hadjivassiliou⁷, Katri Kaukinen⁸, Kamran Rostami⁹, David S Sanders¹⁰, Michael Schumann¹¹, Reiner Ullrich¹¹, Danilo Villalta¹², Umberto Volta¹³, Carlo Catassi^{1,14} and Alessio Fasano^{1*}

Sapone et al. *BMC Medicine* 2012, 10:13

2015



The Journal of Nutrition
Nutritional Epidemiology

Gluten Intake Is Positively Associated with Plasma α_2 -Macroglobulin in Young Adults¹⁻³

Joseph Jamnik,⁴ Bibiana García-Bailo,⁴ Christoph H Borchers,⁵ and Ahmed El-Sohehy^{4*}

⁴Department of Nutritional Sciences, Faculty of Medicine, University of Toronto, Toronto, Canada; and ⁵Genome British Columbia Proteomics Centre, University of Victoria, Victoria, Canada

J Nutr 2015;145:1256–62.

α 2-macroglobulin

- Acute phase protein
 - \uparrow in response to inflammation
 - Protects against the toxic effects of pro-inflammatory cytokines
- Binds to pro-inflammatory cytokines modulating the T-cell response of the immune system

2017

Biomarkers of cardiometabolic health and nutritional status in individuals with positive celiac disease serology

Nutrition and Health
1–9

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DOI: 10.1177/0260106017748053

journals.sagepub.com/home/nah



Joseph Jamnik¹, David JA Jenkins^{1,2} and Ahmed El-Soheemy¹

Conclusions: Individuals with undiagnosed CD may have unfavorable lipid profiles and be at elevated risk for inadequacy of certain fat-soluble vitamins, but not widespread nutrient deficiencies.



Journal of the American College of Nutrition

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/uacn20>

Gluten-Free Diet Reduces Diet Quality and Increases Inflammatory Potential in Non-Celiac Healthy Women

Hirla Karen Fialho Henriques, Luana Moreira Fonseca, Karine Silva de Andrade, Nitin Shivappa, James R. Hébert, Adaliene Versiani Matos Ferreira & Jacqueline Isaura Alvarez Leite

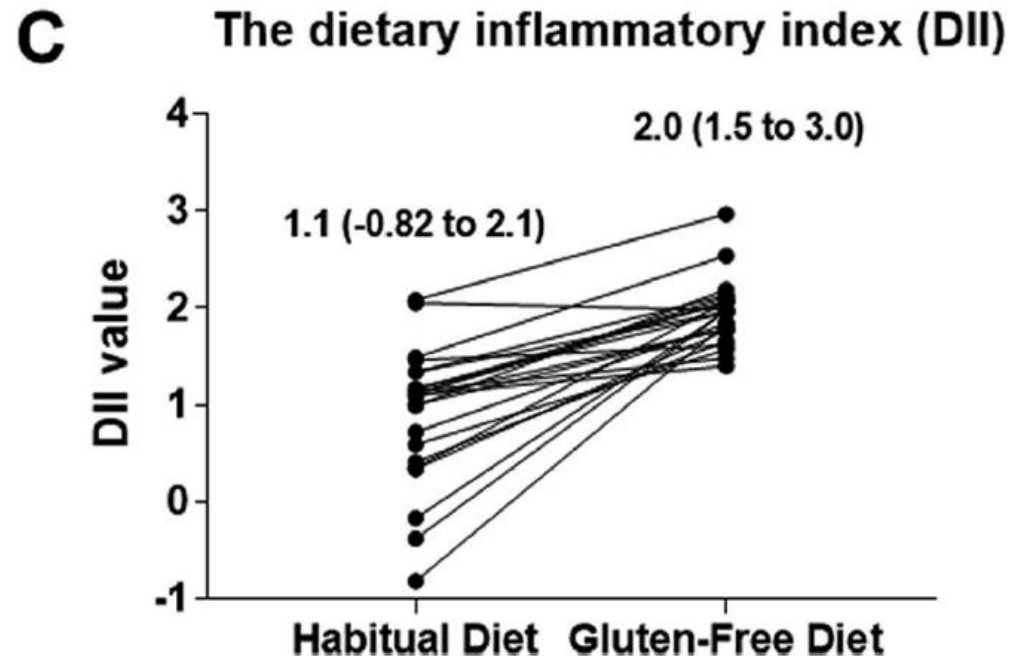
September 2021

Diet Evaluation

GFD resulted in higher fat intake and lower fiber intake

GFD led to reduction in intake of vitamins B1, B6, B12, and folate alongside an increased sodium intake

Nutrient imbalance caused by gluten-free diet resulted in an increase in the dietary inflammatory index



Celiac Disease



OPEN ACCESS

ORIGINAL RESEARCH

bmjmedicine



Association between coeliac disease and cardiovascular disease: prospective analysis of UK Biobank data

Megan Conroy ¹, Naomi Allen,^{1,2} Ben Lacey,¹ Elizabeth Soilleux,³ Thomas Littlejohns ¹

Methods:

- 469,095 adults, of which 2,083 had CD
- 40-69 years of age from England, Scotland, and Wales
- No CVD at baseline assessment visit (2006-2010), followed longitudinally until Oct 2021
- Compared relative risk of CVD, ischaemic heart disease, myocardial infarction, and stroke in people with CD with people who do not have CD.

Results

Table 2 | Distribution of lifestyle and cardiovascular risk factors, by pre-existing coeliac disease

	No coeliac disease	Coeliac disease	
Body mass index	27.3 (27.3 to 27.3)	25.8 (25.6 to 26.0)	↓
Total cholesterol (mmol/L)	5.8 (5.8 to 5.8)	5.5 (5.4 to 5.5)	↓
Log high sensitivity C reactive protein (mg/L)	0.3 (0.3 to 0.3)	0.1 (0.1 to 0.2)	
Non-fasting serum glucose (mmol/L)	5.1 (5.1 to 5.1)	5.1 (5.0 to 5.1)	
Low-density lipoprotein (mmol/L)	3.6 (3.6 to 3.6)	3.4 (3.4 to 3.5)	
Triglyceride (mmol/L)	1.7 (1.7 to 1.7)	1.5 (1.5 to 1.6)	
Glycated haemoglobin (HbA1c) (mmol/mol)	35.9 (35.8 to 35.9)	35.8 (35.5 to 36.0)	
Systolic blood pressure (mm Hg)	137.8 (137.8 to 137.9)	135.7 (135.0 to 136.4)	↓
Diastolic blood pressure (mm Hg)	82.4 (82.4 to 82.5)	80.9 (80.4 to 81.3)	
Diabetes (%):	4.4 (4.4 to 4.5)	3.2 (2.4 to 4.0)	
Type 1 diabetes	0.3 (0.3 to 0.3)	1.0 (0.5 to 1.4)	
Type 2 diabetes	3.7 (3.6 to 3.7)	1.8 (1.2 to 2.4)	
Current smoker (%)	10.4 (10.3 to 10.5)	7.6 (6.5 to 8.8)	↓
At least weekly alcohol drinker (%)	49.3 (49.1 to 49.4)	47.2 (45.0 to 49.3)	
High levels of physical activity (%)*	31.7 (31.5 to 31.8)	29.3 (27.3 to 31.2)	
Using blood pressure lowering medication (%)	17.7 (17.6 to 17.8)	13.7 (12.3 to 15.1)	
Using cholesterol lowering medication (%)	13.2 (13.1 to 13.3)	8.3 (7.2 to 9.4)	
Family history of cardiovascular disease (%)	41.6 (41.5 to 41.8)	44.1 (41.9 to 46.4)	
Ideal cardiovascular disease risk score (%)†	14.3 (14.2 to 14.4)	23.3 (21.6 to 25.1)	↑

Data are percentage (95% confidence interval) or mean (95% confidence interval), adjusted for age, sex, Townsend deprivation index score, education, and ethnicity. Numbers of participants and data missing are presented in the supplementary files.

*High physical activity derived according to the International Physical Activity questionnaire.

†Ideal cardiovascular disease risk score defined according to the American Heart Association's Life's Simple Seven risk score.

Ideal CVD risk score factors:

- Smoking
- Physical Activity
- Total Cholesterol
- Diabetes
- Blood Pressure
- BMI

Conroy et al. *BMJ Medicine* 2023

Results

Despite having lower risk of traditional CVD risk factors, individuals with CD had a higher incidence rate of CVD:

- 9.0 CVD cases per 1000 person years among those with CD vs.
- 7.4 CVD cases per 1000 person years among those without CD

Table 3 | Association between coeliac disease and cardiovascular disease (CVD) outcomes, with progressive adjustments

	Cases in participants with coeliac disease (n=2083)	Cases in participants with no coeliac disease (n=467 012)	Hazard ratio (95% CI)	P value	χ^2
All CVD disease:					
Standard adjustments	218	40 469	1.27 (1.11 to 1.45)	<0.001	11.1
Lifestyle factors	218	40 469	1.27 (1.11 to 1.45)	<0.001	11.2
Major CVD risk factors	218	40 469	1.44 (1.26 to 1.65)	<0.001	25.3
Ischaemic heart disease:					
Standard adjustments	182	33 374	1.30 (1.12 to 1.50)	<0.001	11.3
Lifestyle factors	182	33 374	1.30 (1.12 to 1.50)	<0.001	11.2
Major CVD risk factors	182	33 374	1.5 (1.30 to 1.75)	<0.001	26.5
Myocardial Infarction:					
Standard adjustments	70	12 783	1.34 (1.06 to 1.70)	0.01	5.5
Lifestyle factors	70	12 783	1.35 (1.07 to 1.71)	0.01	5.8
Major CVD risk factors	70	12 783	1.59 (1.25 to 2.01)	<0.001	12.7
Stroke:					
Standard adjustments	46	8813	1.13 (0.85 to 1.52)	0.39	0.7
Lifestyle factor	46	8813	1.15 (0.86 to 1.53)	0.35	0.8
Major CVD risk factors	46	8813	1.20 (0.89 to 1.60)	0.23	1.4

Hazard ratios are progressively adjusted for a standard set of adjustments, lifestyle factors, and major CVD risk factors. Standard adjustments are for region, sex, Townsend deprivation index score, education, year of birth, year of recruitment and ethnicity, with age as underlying time variable; lifestyle factors adjustments are for physical activity, smoking, and alcohol consumption; and major cardiovascular risk factors adjustments are for body mass index, total cholesterol, glucose, blood pressure, antihypertensive medication, cholesterol lowering medication, family history of heart disease, and diabetes. CI=confidence interval.

Lactose Intolerance

Lactose Intolerance

(Lactase Non-Persistence)

- Inability to metabolize lactose into glucose and galactose
- Determined by genetic polymorphism in lactase (LCT) gene or MCM6
 - People with particular gene variant produce less lactase
- Undigested lactose cannot be absorbed by the intestine and passes into the colon
 - Colonic bacteria metabolize it into CO₂ and H₂O

**Not to be confused with milk allergy – allergy to milk proteins
(specifically alpha-casein)**

Lactose Intolerance

(Lactase Non-Persistence)

- A Mendelian-recessive phenotype
- Gene-culture Coevolution Theory = genetic x history of dairy practices



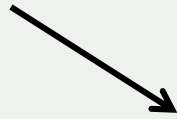
Curry, Nature 500, 2013

Simon, F.J. Am. J. Dig. Dis. 15, 1970

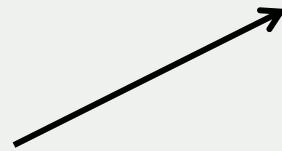
McCracken, Curr. Anthropol 12, 1971

Expression of lactase gene throughout lifecycle

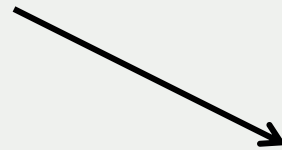
Fetus
Low expression



Infant
High expression

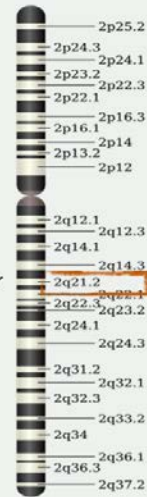


Adult
High expression
“Lactase persistence”
(Lactose-tolerant)



Adult
Low expression
“Lactase non-persistence”
(Lactose-intolerant)

LCT-13910C>T



MCM6 gene 36.2 kb

Intron 13

TAAGTTACCA.....AAGATAATGTAGCCCTG....

-13910 C - T Substitution

The sucrase-to-lactase (S:L) enzyme activity ratio

S:L >2

S:L ≤ 2

Lactase non-persistent (LNP) (Lactose intolerance)

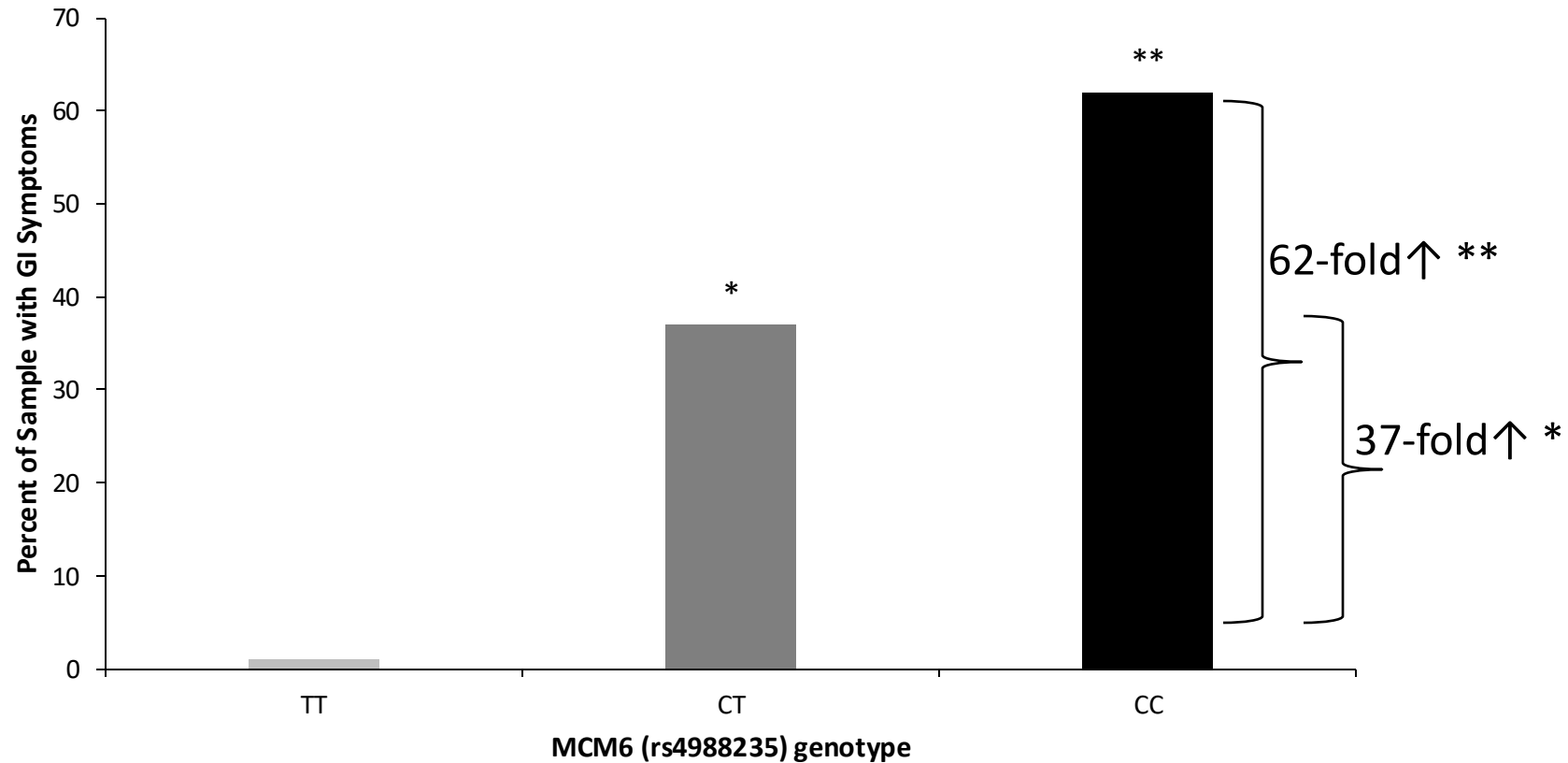
Lactase persistent (LP) (Lactose tolerance)

CC = 3.9 U/g proteins

CT = 17.3 U/g proteins

TT = 30.9 U/g proteins

Percent of participants with gastrointestinal (GI) symptoms related to dairy ingestion by MCM6 genotype



* Significantly greater GI symptoms related to dairy ingestion in individuals with the CT and CC genotypes.

2016

nature
structural &
molecular biology

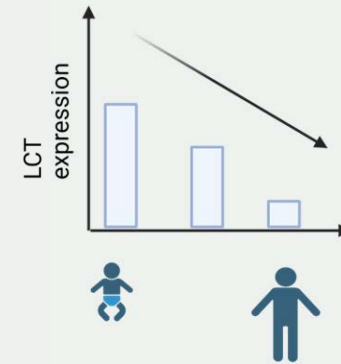
Lactase nonpersistence is directed by DNA-variation-dependent epigenetic aging

Viviane Labrie^{1-3,12}, Orion J Buske^{4,5,12}, Edward Oh¹, Richie Jeremian¹, Carolyn Ptak¹, Giedrius Gasitonas⁶, Almantas Maleckas⁷, Rūta Petereit⁸, Aida Žvirbliene^{8,9}, Kęstutis Adamonis⁸, Edita Kriukienė¹⁰, Karolis Koncevičius¹¹, Juozas Gordevičius¹¹, Akhil Nair¹, Aiping Zhang¹, Sasha Ebrahimi¹, Gabriel Oh¹, Virginijus Šikšnys⁶, Limas Kupčinskas^{8,9}, Michael Brudno^{4,5} & Arturas Petronis^{1,2}

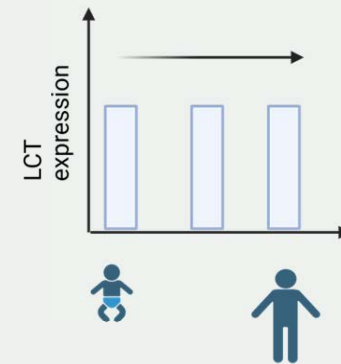
VOLUME 23 NUMBER 6 JUNE 2016 NATURE STRUCTURAL & MOLECULAR BIOLOGY

Differential Epigenetic Modification

Lactase non-persistence (lactose intolerant)



Lactase persistence (lactose tolerant)



With age, C allele accumulates DNA modifications that decrease *LCT* expression.

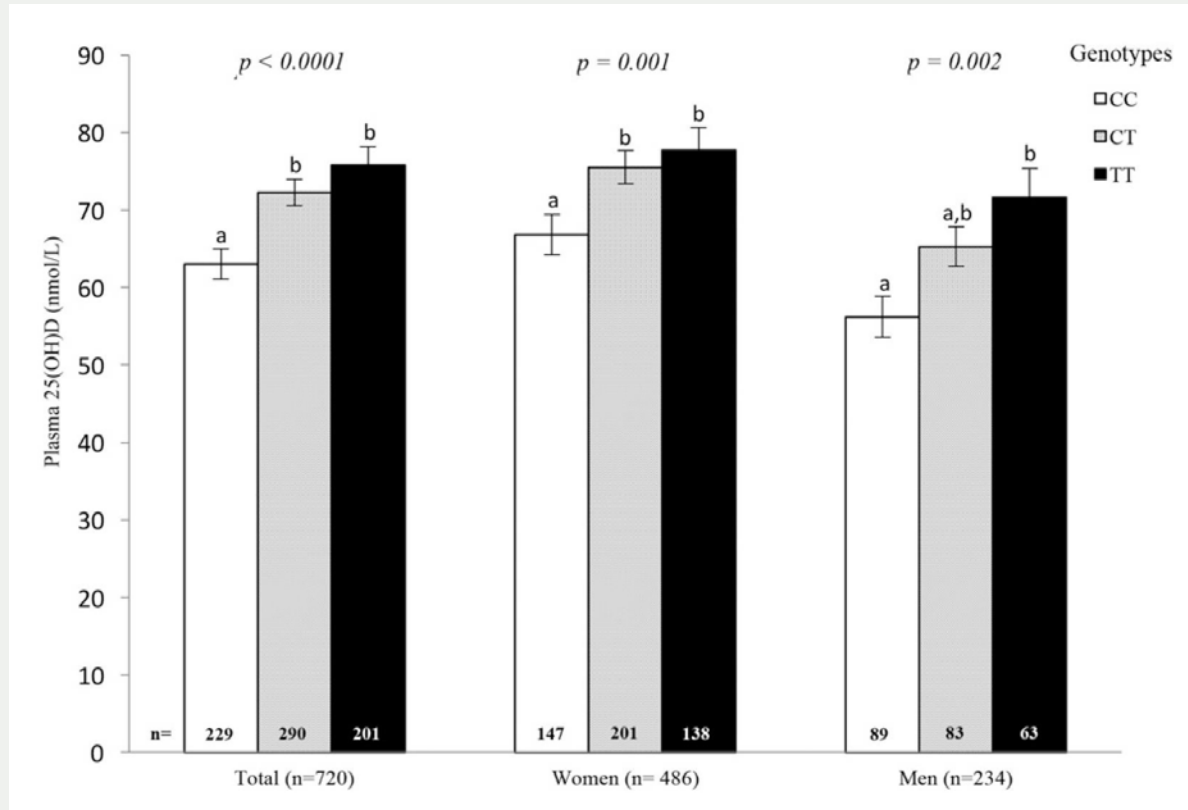
2017

Lactose Intolerance (*LCT*-13910C>T) Genotype Is Associated with Plasma 25-Hydroxyvitamin D Concentrations in Caucasians: A Mendelian Randomization Study^{1,2}

Ohood Alharbi and Ahmed El-Soheemy*

The Journal of Nutrition

J Nutr doi: 10.3945/jn.116.246108.



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Lactose intolerance linked to lower vitamin D levels

By Honor Whiteman | Published Tuesday 16 May 2017



Researchers have associated lactose intolerance with lower levels of vitamin D.

A new study suggests that people with a genetic intolerance to lactose should increase their intake of non-dairy foods rich in vitamin D, after finding that they are more likely to have low levels of the essential nutrient.

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SPOTLIGHT ON:

Food Intolerance



What Is Celiac Disease?



What is the difference between food allergy and food intolerance?



What is food intolerance?



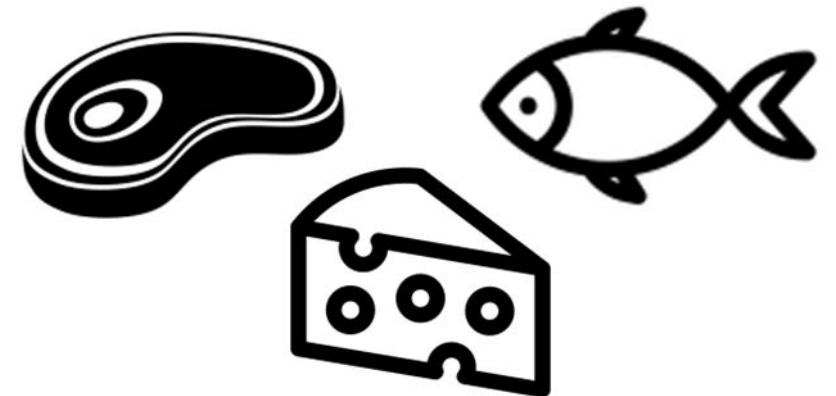
What is lactose intolerance?

Histamine Intolerance

Histamine Intolerance (HIT)

- Sensitivity to histamine in the diet
- Histamine formed in foods through microbial enzymatic degradation of histidine
- Associated with an accumulation of dietary histamine due to impaired enzymatic degradation
- Approximately 1-3% of the population has HIT^{1,2}

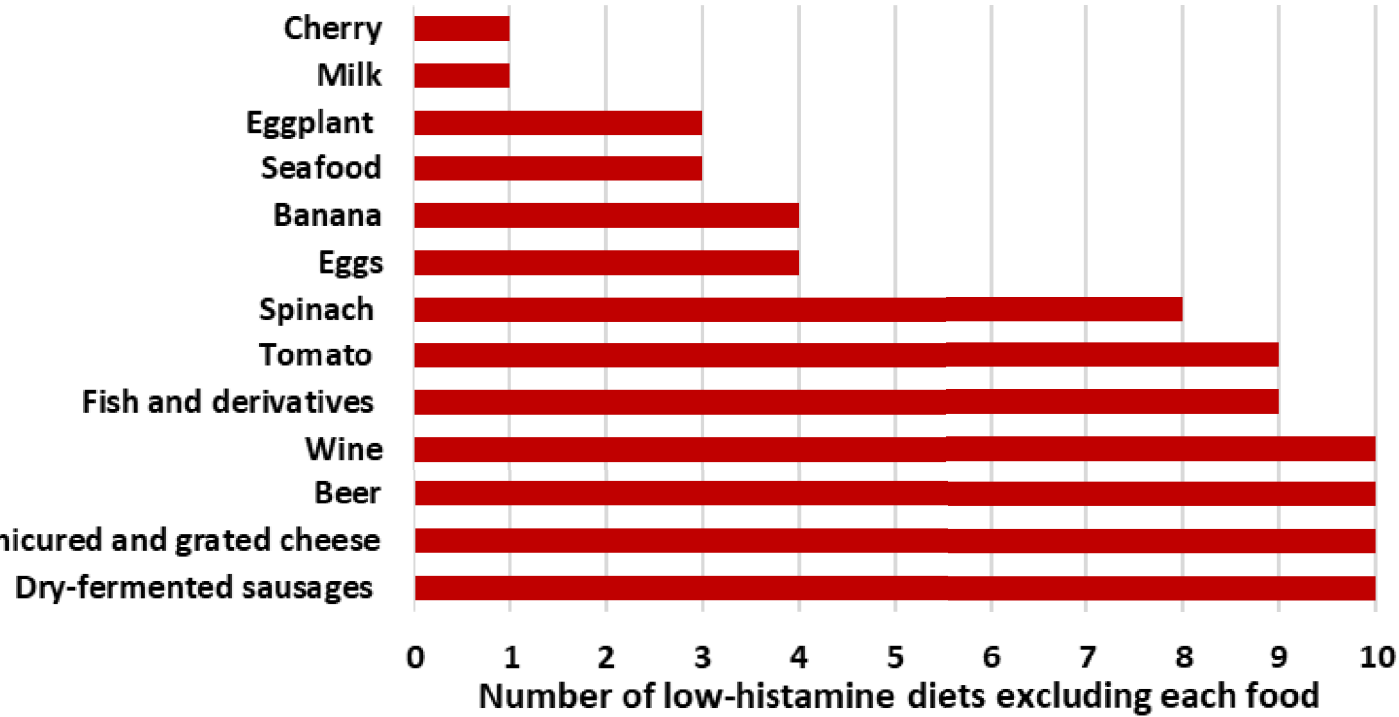
➤ High levels in fermented and processed meats, fish, and cheese



1. Maintz, Laura, and Natalija Novak. (2007). The American Journal of Clinical Nutrition, vol. 85, no. 5, pp. 1185–96.
2. Comas-Basté, O., Sánchez-Pérez, S., Veciana-Nogués, M. T., Latorre-Moratalla, M., & Vidal-Carou, M. del C. (2020). Biomolecules, 10(8), 1181.

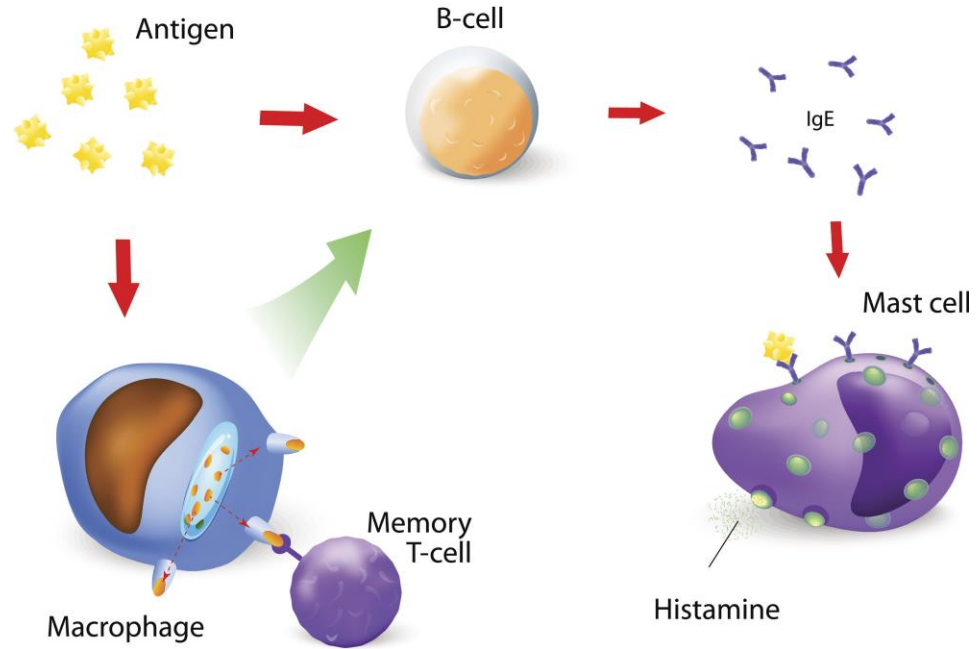
Foods and Low-Histamine Diets in the Literature

Foods avoided in 10 low-histamine diets

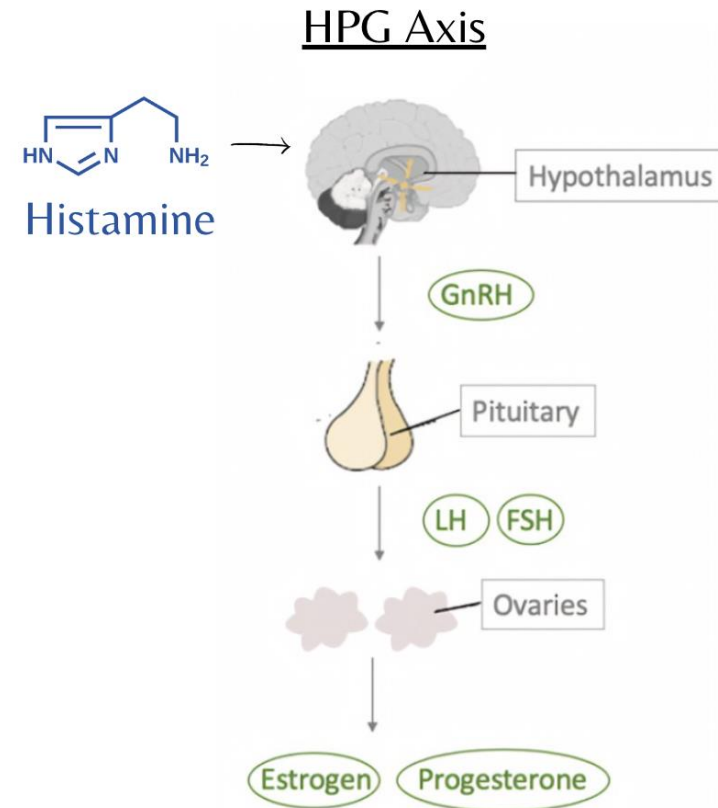


Histamine

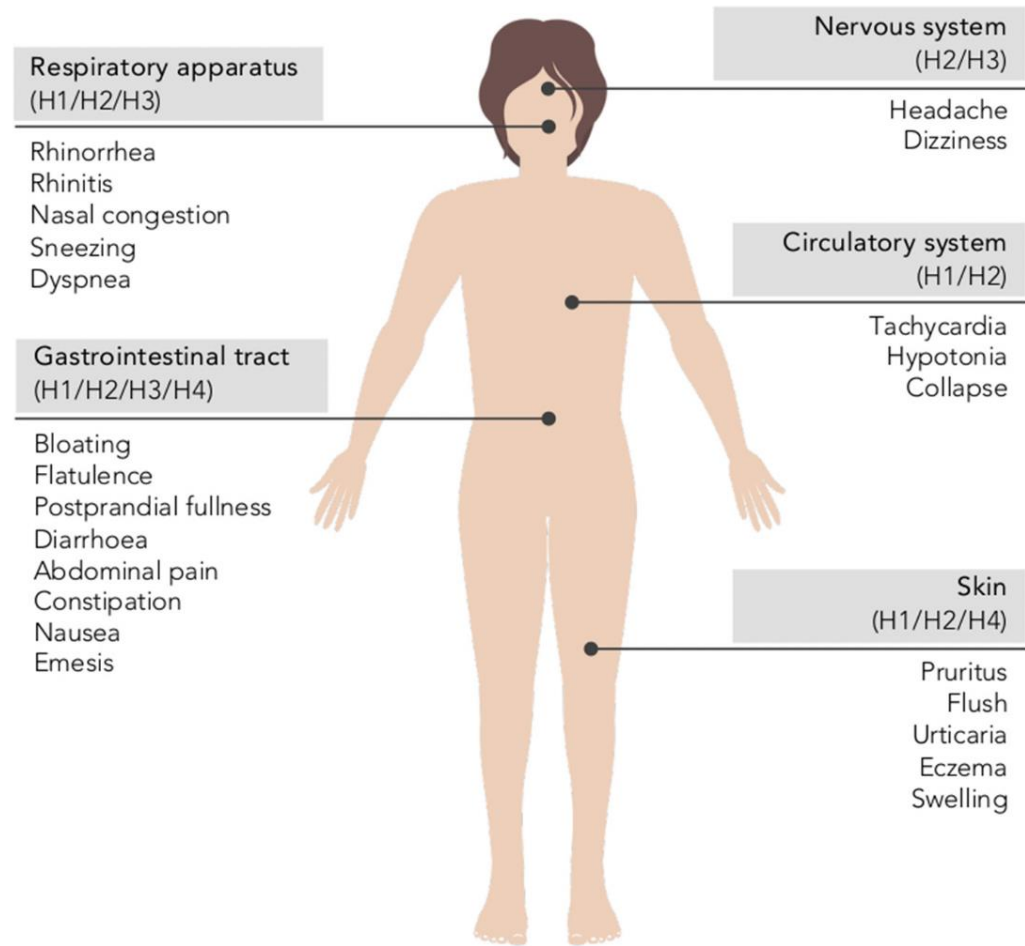
Inflammatory marker



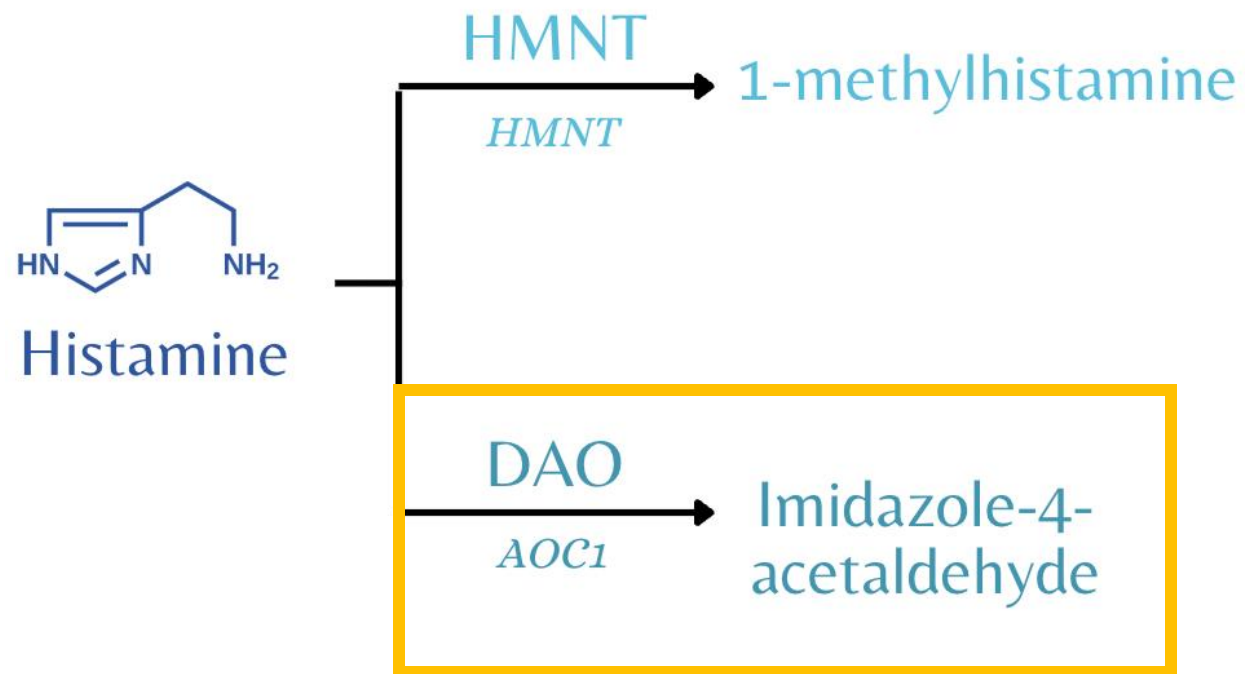
Neurotransmitter



Histamine Intolerance (HIT)



Histamine Metabolism



ORIGINAL ARTICLE |  Full Access |

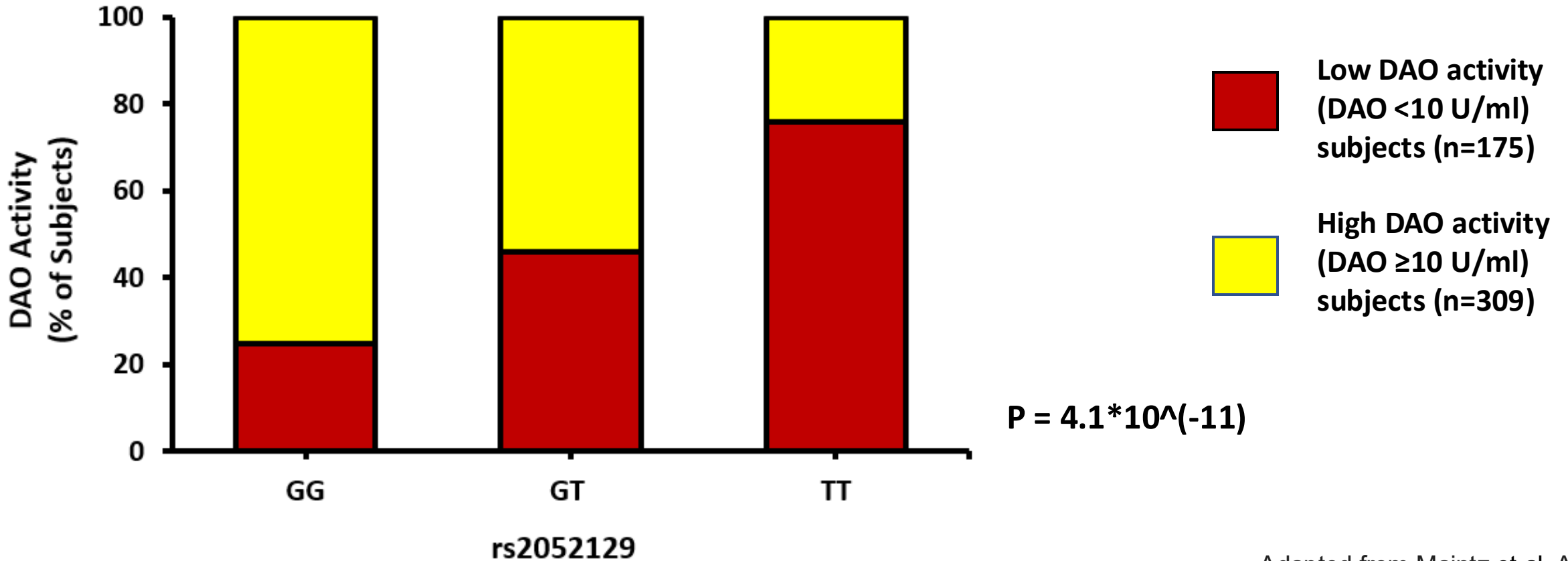
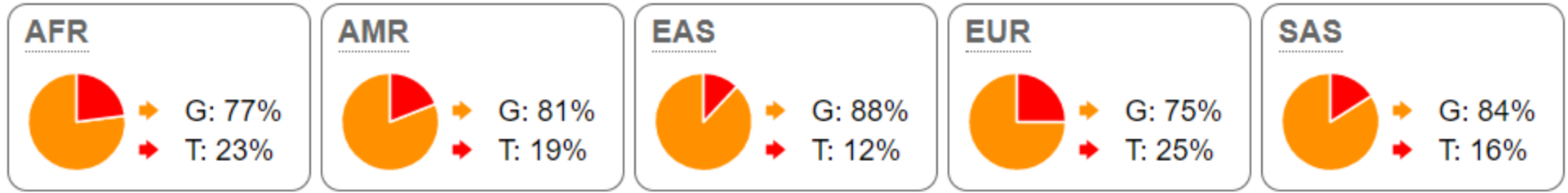
Association of single nucleotide polymorphisms in the *diamine oxidase* gene with diamine oxidase serum activities

L. Maintz, C.-F. Yu, E. Rodríguez, H. Baurecht, T. Bieber, T. Illig, S. Weidinger, N. Novak

First published: 13 April 2011 |

<https://doi-org.myaccess.library.utoronto.ca/10.1111/j.1398-9995.2011.02548.x> | Citations: 37

DAO Activity of by Genotype





Meta Gene

Volume 24, June 2020, 100619



Association of Diamine oxidase (*DAO*) variants with the risk for migraine from North Indian population

Sukhvinder Kaur ^a  , Arif Ali ^b, Yaser Siahbalaei ^c, Uzair Ahmad ^c, Fazila Nargis ^c, A.K. Pandey ^d, Balkirat Singh ^e

Received 31 July 2019, Revised 7 October 2019, Accepted 9 October 2019, Available online 16 October 2019.

<https://doi.org/10.1016/j.mgene.2019.100619>

Growing Interest in HIT



Review

Histamine Intolerance: T1

Oriol Comas-Basté ^{1,2}
Mariluz Latorre-Moratalla



ELSEVIER

Clinical Nutrition

Volume 38, Issue 1, February 2019, Pages 152-158



Randomized Control Trials

Diamine oxidase (DAO) supplement reduces headache in patients with DAO deficiency: a randomized double-blind placebo-controlled trial

Stefan Schmid-Grendelmeier ³ and Daniel Pohl ^{4,*}



nutrients



Joan Izquierdo-Casas ^{a, b}, Oriol Comas-Basté ^{a, b},
Gascón ^b, Adriana Duelo ^d, Luis Soler-

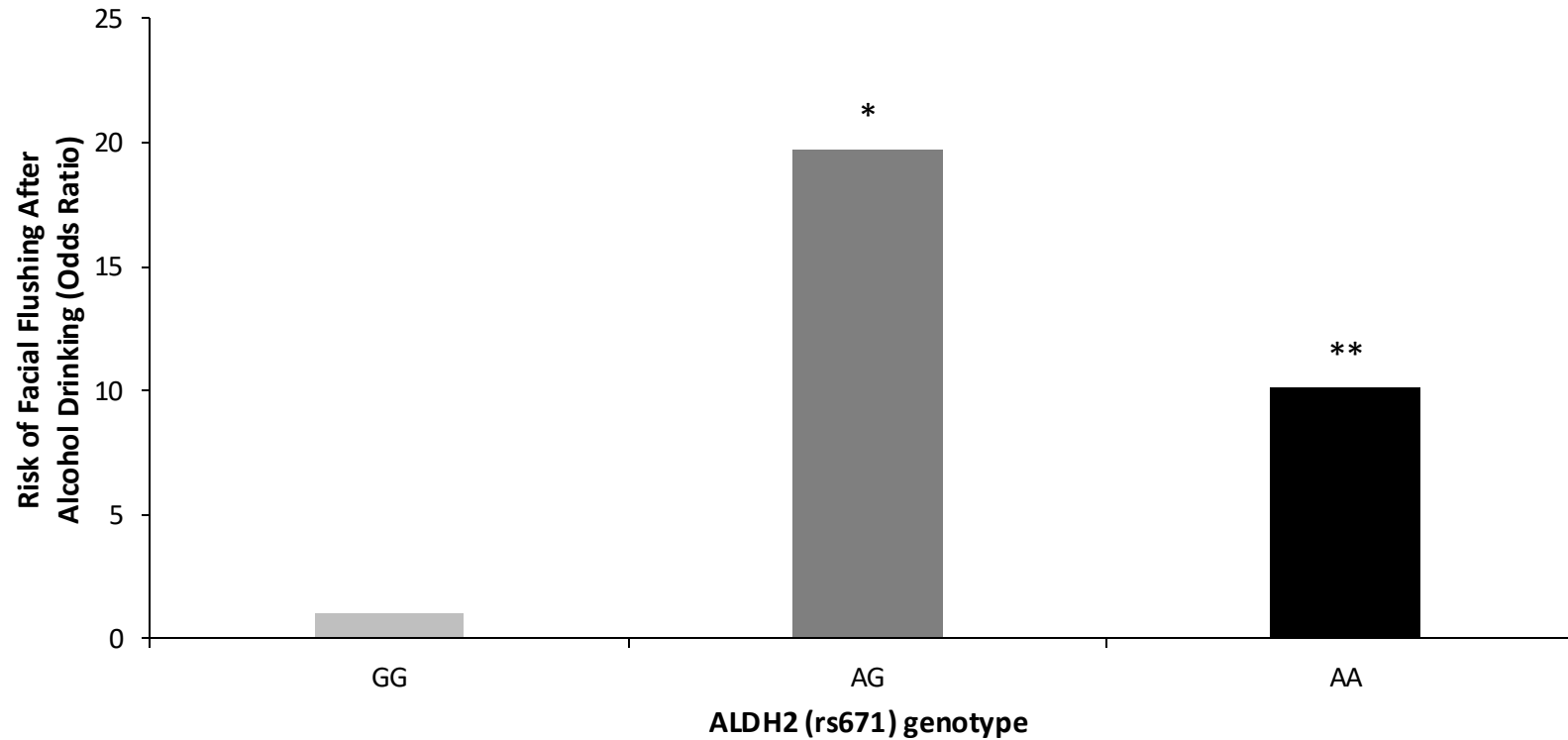
Article

Low-Histamine Diets: Is the Exclusion of Foods Justified by Their Histamine Content?

Sònia Sánchez-Pérez ^{1,2,3}, Oriol Comas-Basté ^{1,2,3} , M. Teresa Veciana-Nogués ^{1,2,3},
M. Luz Latorre-Moratalla ^{1,2,3} and M. Carmen Vidal-Carou ^{1,2,3,*}

Food Sensitivities

Sensitivity to Alcohol by ALDH2 Genotype

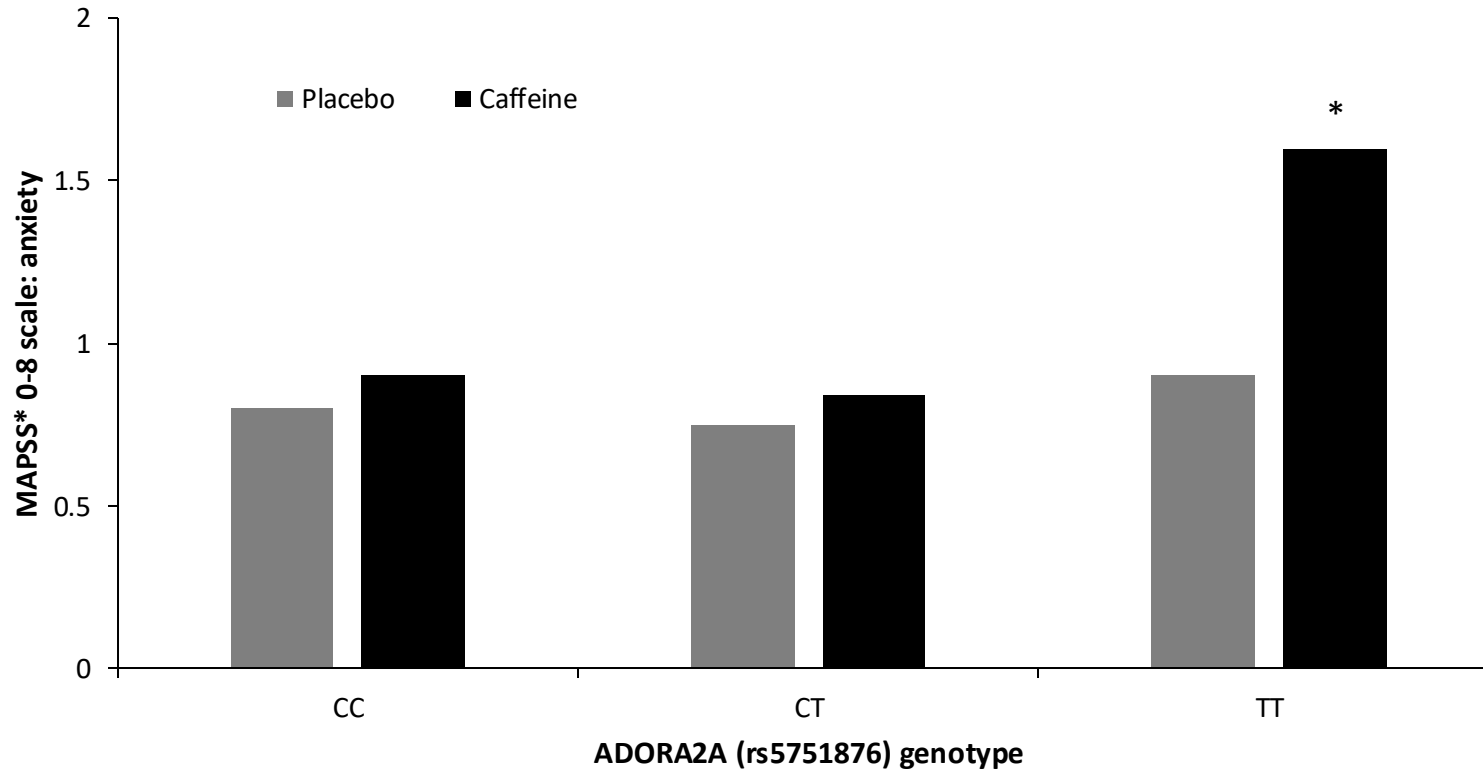


*Reference category: GG. OR = 19.7, 95 % CI 10.8–35.7, $p < 0.001$;

** Reference category: GG. OR = 10.1, 95 % CI 4.0–25.8, $p < 0.01$.

Adapted from Hashimoto et al. Environ Health Prev Med 2016;21(3):138-48.

Sensitivity to Caffeine by ADORA2A



*MAPSS:
Measure of
anxiety

100 mg caffeine effect (post) on anxiety as a function of *ADORA2A* rs5751876 genotype group.

** $p < 0.01$ for caffeine vs placebo within TT genotype (Bonferroni *t*).

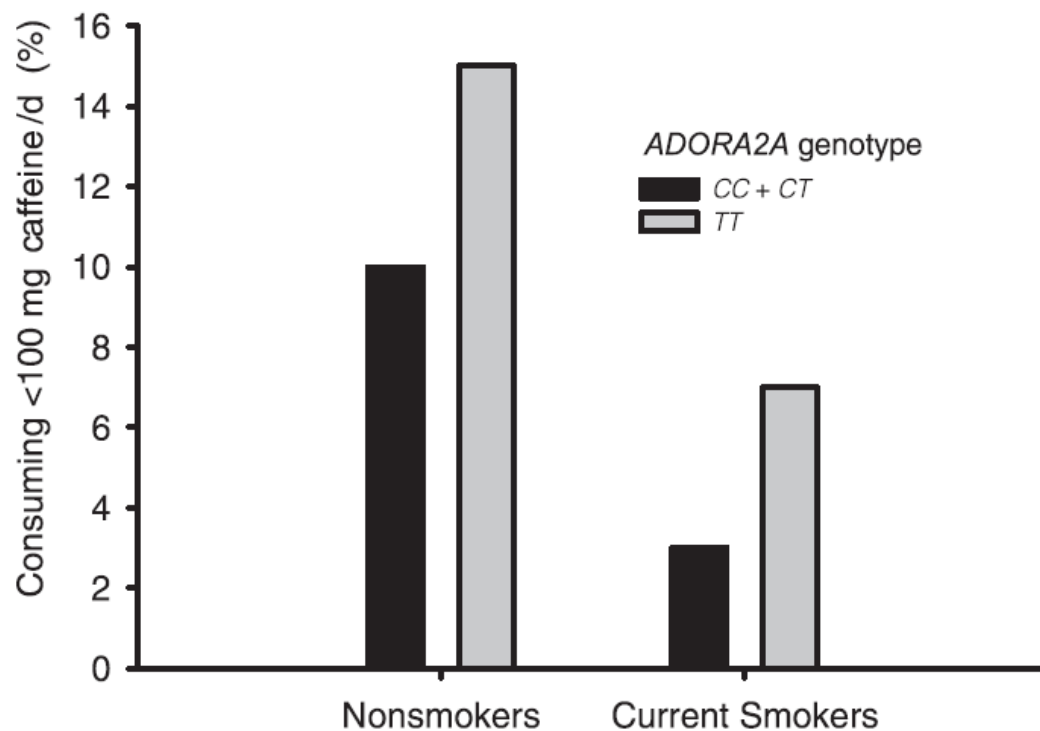
Adapted from Rogers et al. Neuropsychopharmacology. 2010. 35:1973-83

ADORA2A and Caffeine

Genetic polymorphism of the adenosine A_{2A} receptor is associated with habitual caffeine consumption¹⁻³

Marilyn C Cornelis, Ahmed El-Sohemy, and Hannia Campos

Am J Clin Nutr 2007;86:240-4.



Summary

6 genetic variants in HLA impact risk of Gluten intolerance

Variation in the MCM6 (LCT) gene predicts Lactose intolerance

3 Variants in the AOC1 gene affects Histamine intolerance

A variant in ALDH2 affects alcohol sensitivity

A variant in ADORA2A affects caffeine sensitivity

Presentation Clinical Actions

After participating in this presentation, clinicians should be better able to:

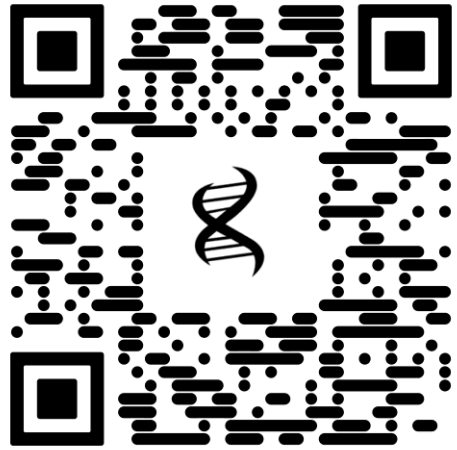
- Recommend suitable genetic tests for food intolerances.
- Evaluate the quality of the diet of clients with food intolerances.

Benefits of Genetic Testing

- ✓ Identify unknown food intolerances
- ✓ Improved nutritional status
- ✓ Greater weight loss
- ✓ Improved compliance
- ✓ Enhanced motivation
- ✓ Better understanding of dietary advice



Thank you



Q&A



Email: a.el.sohemy@nutrigenomix.com

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