AHMEDEL-SOHEMY, PhD
Professor & Associate Chair
Department of Nutritional Sciences
Faculty of Medicine
University of Toronto

Chief Science Officer
Nutrigenomix Inc.

Genetic Testing for Personalized Nutrition
Science & Practical Applications

The Science of NUTRIGENOMICS

using genetic testing to determine why individuals respond differently to the same foods, beverages and supplements they consume.

2008

Physiol Genomics 33: 355–360, 2008.
First published March 18, 2008; doi:10.1152/physiolgenomics.00148.2007.

Genetic variant in the glucose transporter type 2 is associated with higher intakes of sugars in two distinct populations

Karen M. Eny,[1] Thomas M. S. Wolever,[1,2] Bénédicte Fontaine-Bisson,[1] and Ahmed El-Sohemy[1]
[1]*Department of Nutritional Sciences, University of Toronto; and* [2]*St. Michael's Hospital, Toronto, Canada*

Submitted 10 July 2007; accepted in final form 14 March 2008

Ile → ↑ **Sugar intake**

Thr → ↓ **Sugar intake**

Craving something sweet? Blame it on your DNA

JOSEPH HALL
HEALTH REPORTER

If you have a sweet tooth, it won't be found amongst your molars or canines. It's inserted in your DNA instead.

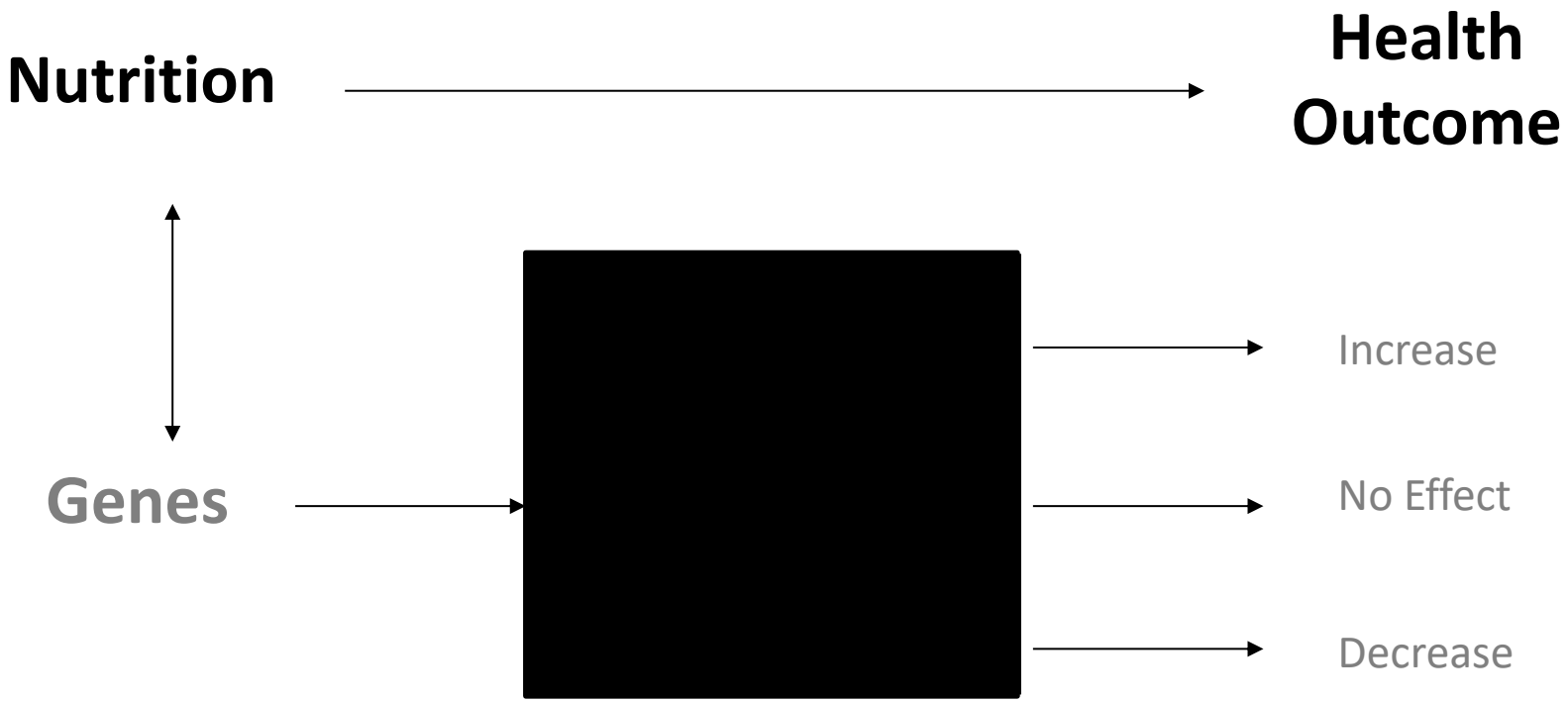
Cake and cola and cookie lovers may well be able to blame their cravings on a common variant of a gene that controls the brain's ability to sense sugars in the body, a new University of Toronto study suggests. About one in five people has the variant.

The gene may also have implications for a person's risk of getting diabetes.

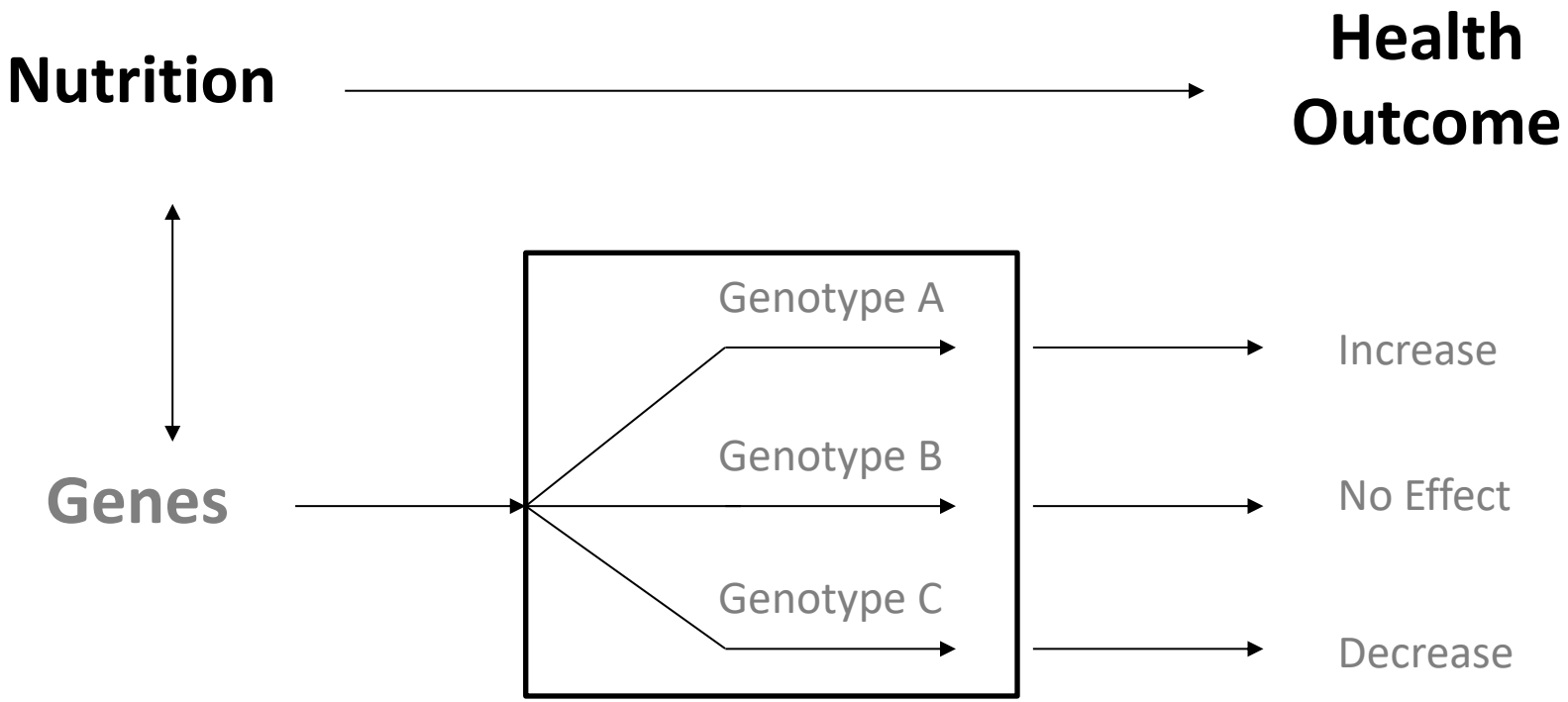
"In humans this gene functions as a glucose sensor in the brain to regulate appetite or food intake," says U of T nutrition expert

SUGAR continued on **A17**

The Science of Nutrigenomics



The Science of Nutrigenomics

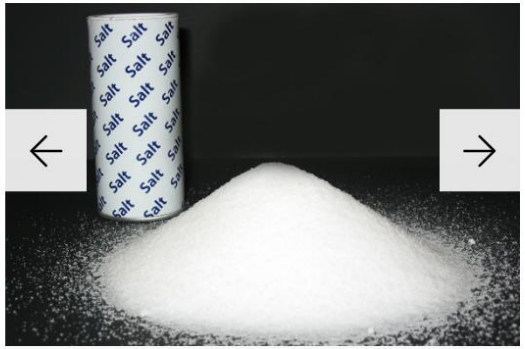


Categories: Scientific Conferences & Meetings, Heart News, Stroke News & Brain Health | **Published: November 11, 2023**

Reducing sodium intake significantly lowered blood pressure in as little as one week

American Heart Association Scientific Sessions 2023, Late-Breaking Science Abstract in LBS.04

Related Images



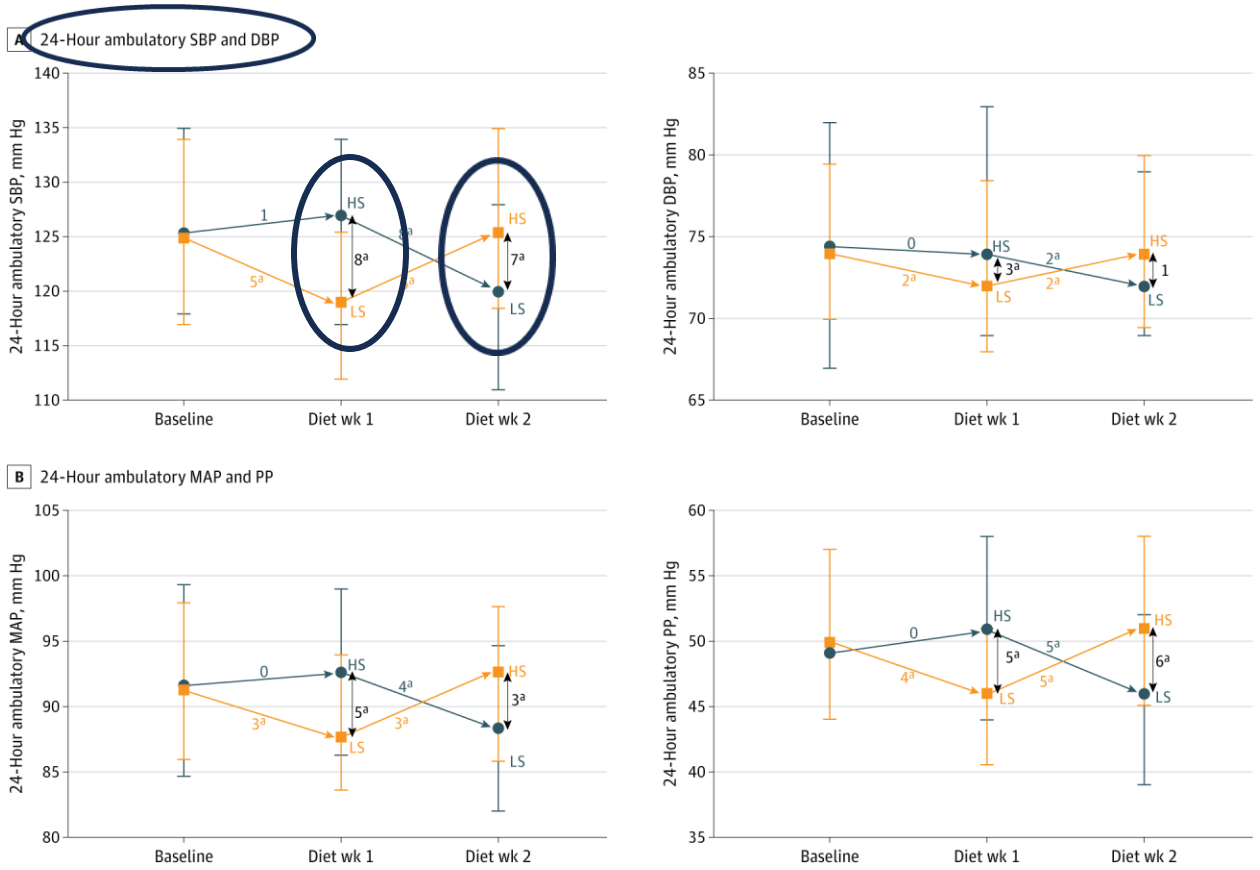
Salt

Pile of salt.

Download (888.2 kB)

From: **Effect of Dietary Sodium on Blood Pressure: A Crossover Trial**

JAMA. Published online November 11, 2023. doi:10.1001/jama.2023.23651



From: **Effect of Dietary Sodium on Blood Pressure: A Crossover Trial**

JAMA. Published online November 11, 2023. doi:10.1001/jama.2023.23651

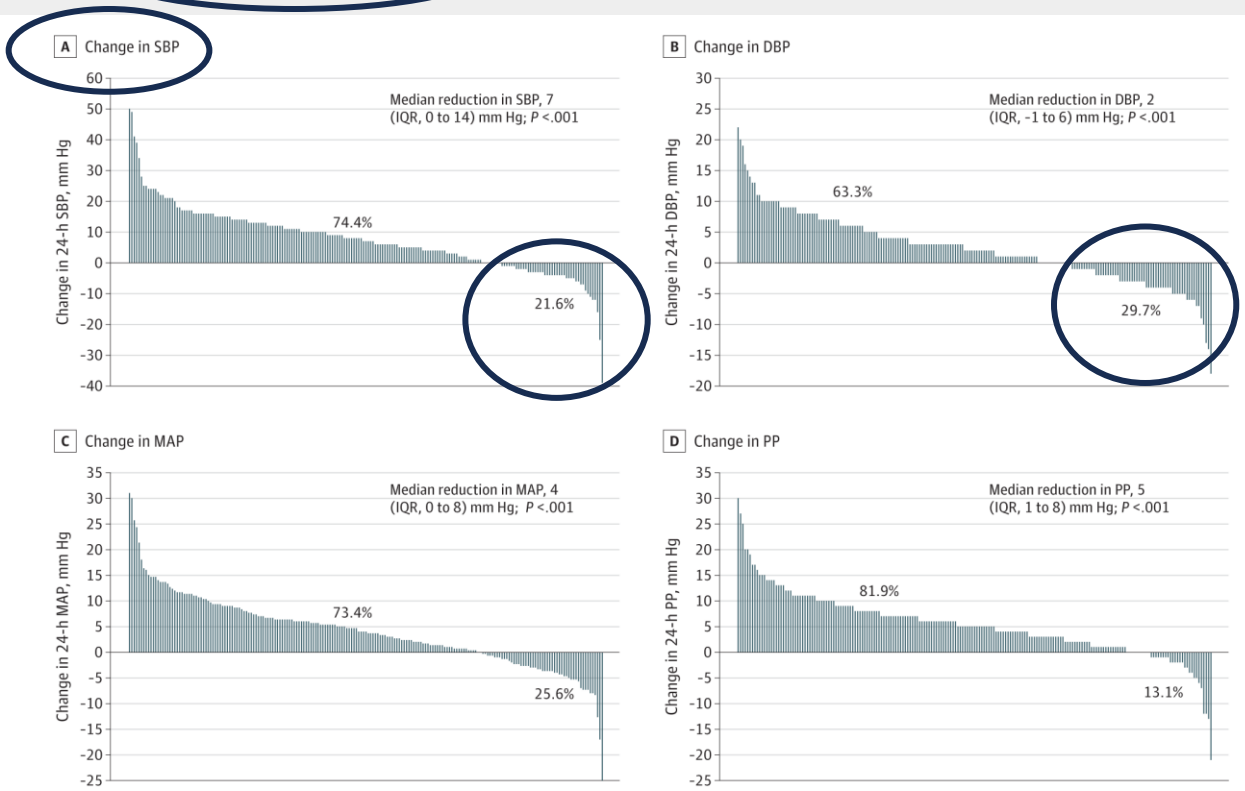
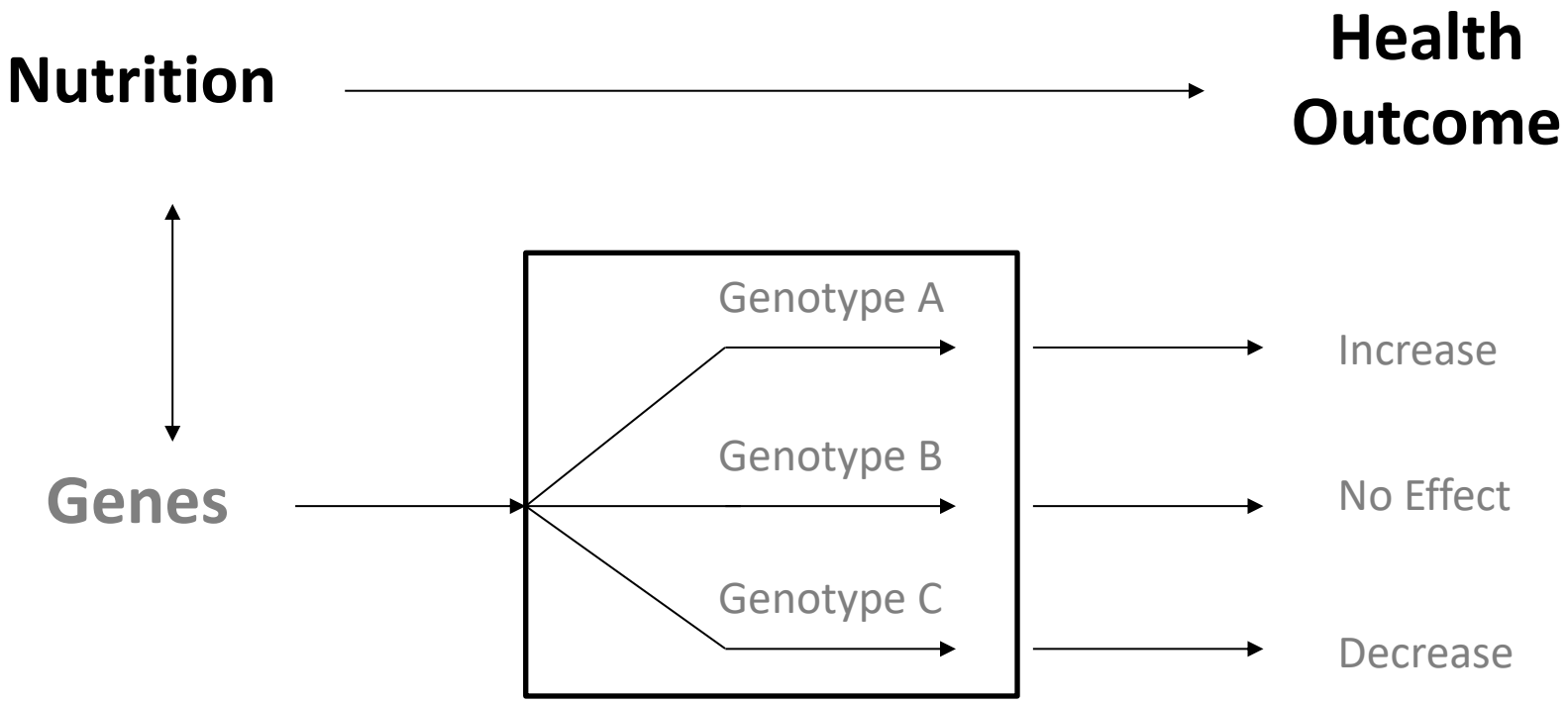


Figure Legend:

Distributions of Within-Individual 24-Hour Ambulatory BP Response to Dietary Sodium Intake, Calculated From High-Sodium Diet Minus Low-Sodium DietBP indicates blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; PP, pulse pressure; and SBP, systolic blood pressure. Bars above 0 reflect a reduction in BP during low-sodium diet vs high-sodium diet; bars below 0 reflect an increase in BP during low-sodium diet vs high-sodium diet. Percentages above 0 reflect proportion of individuals who experienced a reduction in BP during low-sodium diet vs high-sodium diet; percentages below 0 reflect proportion of individuals who experienced an increase in BP during low-sodium diet vs high-sodium diet. P values based on Wilcoxon signed rank test.

The Science of Nutrigenomics

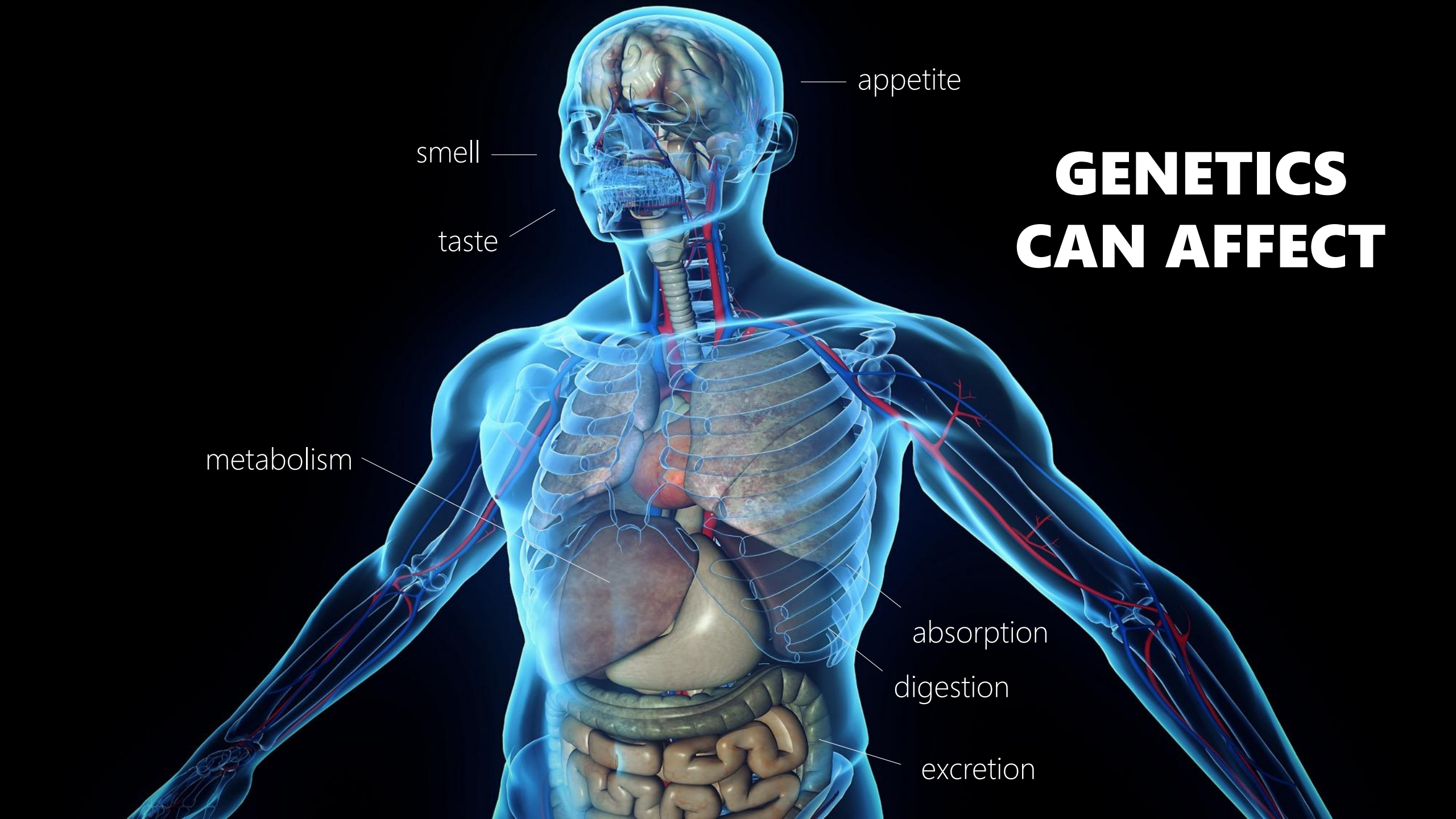


One size does not fit all


One man's food is another man's poison
- Lucretius (99-55 BC)

Human Genetic Variation

Common Genetic Variants



GENETICS CAN AFFECT

2007

Genetics may define diets of the future

Scientists look at how personalized nutrition could change how and what we eat

By Carrie Peyton Dahlberg
BEE STAFF WRITER

Deep in each person's genetic code may lie the answers to which medicines can help them, which environmental toxins can kill them, and even which foods they should eat to live well.

The tantalizing prospect of personally tailored diets, dictated by our genetic makeup, drew hundreds of scientists and dietitians from around the world to UC Davis over the weekend for a conference on nutritional genomics.

The fast-growing field "will be huge," said Jim Kaput, who next month will take over as head of the U.S. Food and Drug Administration's division of personalized nutrition and medicine. "We are definitely not ready for it."

In interviews, Kaput and other con-

▶ GENETICS, Page A10

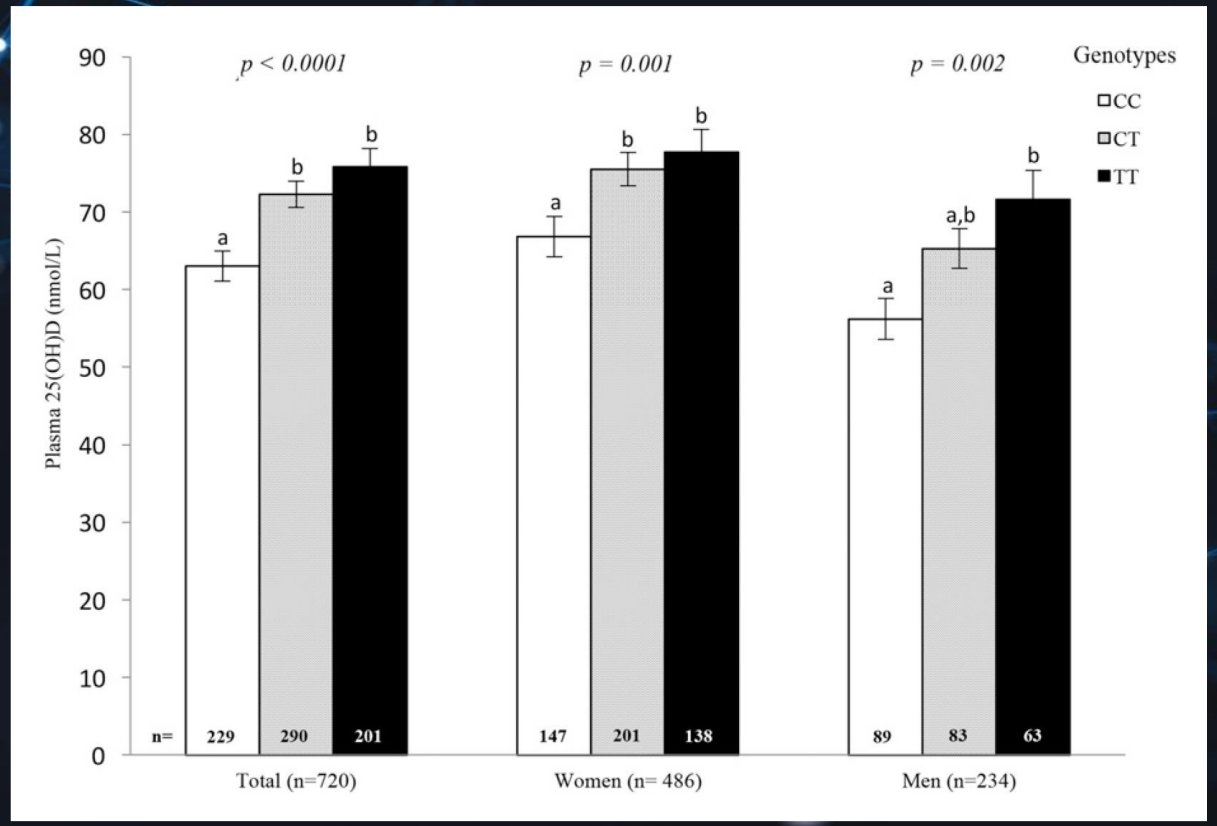

Lactaid
ENJOY ICE CREAM AGAIN!
Cookies & Cream
100% Lactose Free Ice Cream
Real Ice Cream
NO DISCOMFORT!
1 QUART (946 mL)
Organic
Half & Half
Ultra Pasteurized
WE NEVER USE: Antibiotics GMOs Toxic Pesticides Synthetic Hormones
Lactose Free
Half & Half
ORGANIC VALLEY
LACTOSE FREE
USDA ORGANIC
Lactose Free
QUART (946 mL)
Lactose Free
Half & Half
Ultra Pasteurized
Grade A

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-Sohemy*

The Journal of Nutrition
J Nutr doi: 10.3945/jn.116.246108.



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.

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?

2016

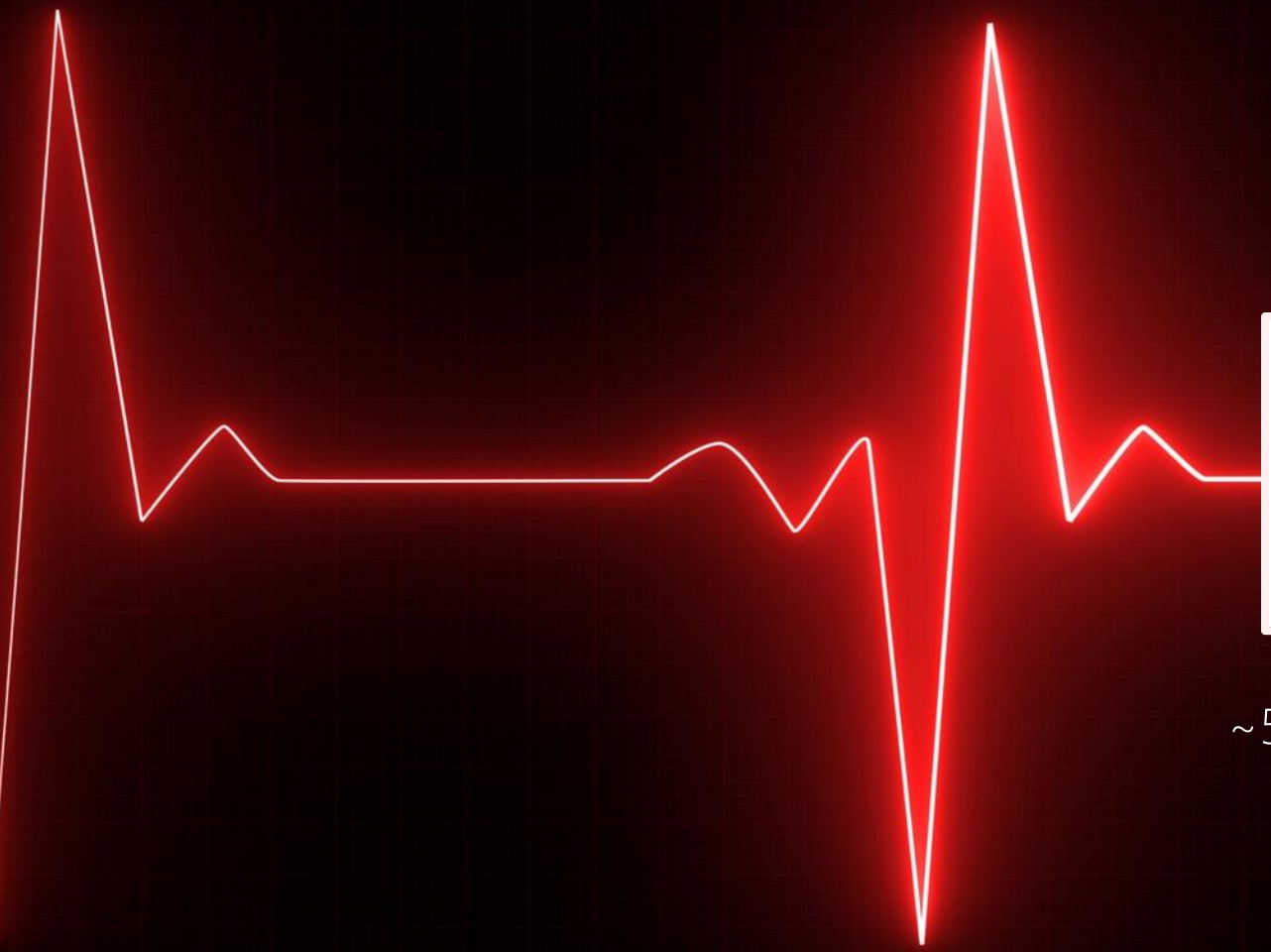
nature structural & molecular biology

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

Viviane Labrie[1–3,12], Orion J Buske[4,5,12], Edward Oh[1], Richie Jeremian[1], Carolyn Ptak[1], Giedrius Gasiūnas[6], Almantas Maleckas[7], Rūta Petereit[8], Aida Žvirbliene[8,9], Kęstutis Adamonis[8], Edita Kriukienė[10], Karolis Koncevičius[11], Juozas Gordevičius[11], Akhil Nair[1], Aiping Zhang[1], Sasha Ebrahimi[1], Gabriel Oh[1], Virginijus Šikšnys[6], Limas Kupčinskas[8,9], Michael Brudno[4,5] & Arturas Petronis[1,2]

VOLUME 23 NUMBER 6 JUNE 2016 NATURE STRUCTURAL & MOLECULAR BIOLOGY

Cardiometabolic disease is the #1 cause of death and disability among US adults



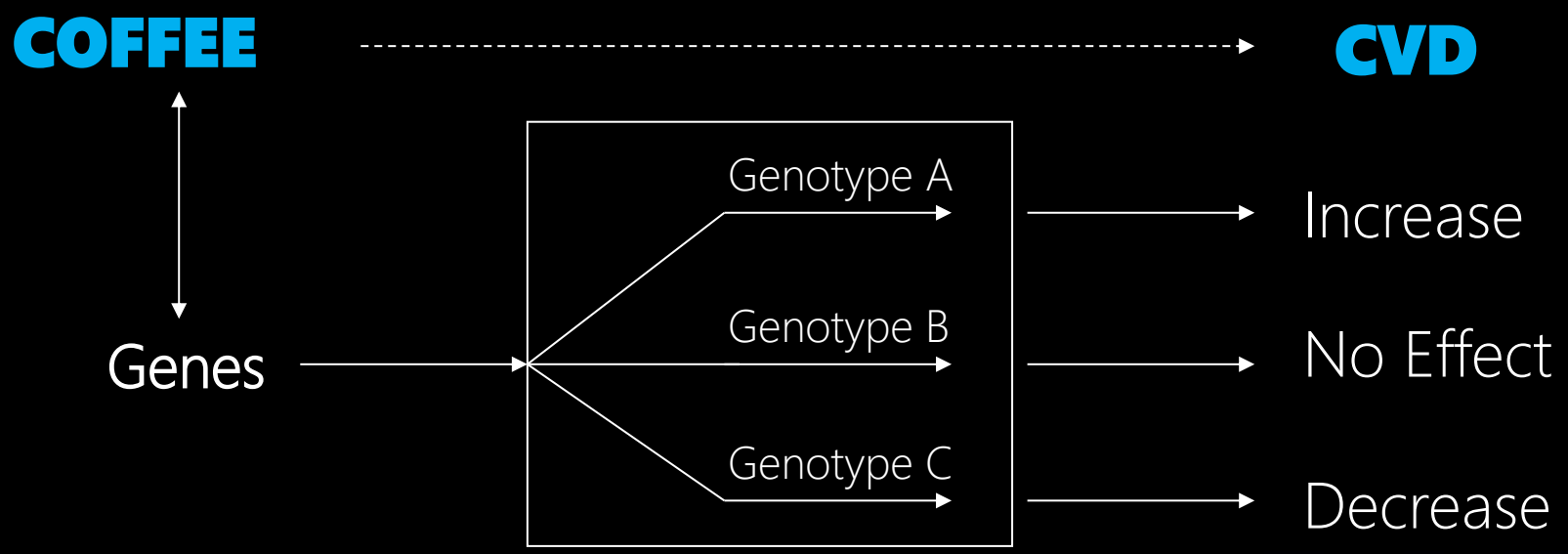
JAMA | Original Investigation

Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States

Renata Micha, RD, PhD; Jose L. Peñalvo, PhD; Frederick Cudhea, PhD; Fumiaki Imamura, PhD; Colin D. Rehm, PhD; Dariush Mozaffarian, MD, DrPH

~50% of cardiometabolic deaths are attributable to poor diet

Is coffee associated with CVD?



Bioactives in Coffee

aliphatic acids

potassium

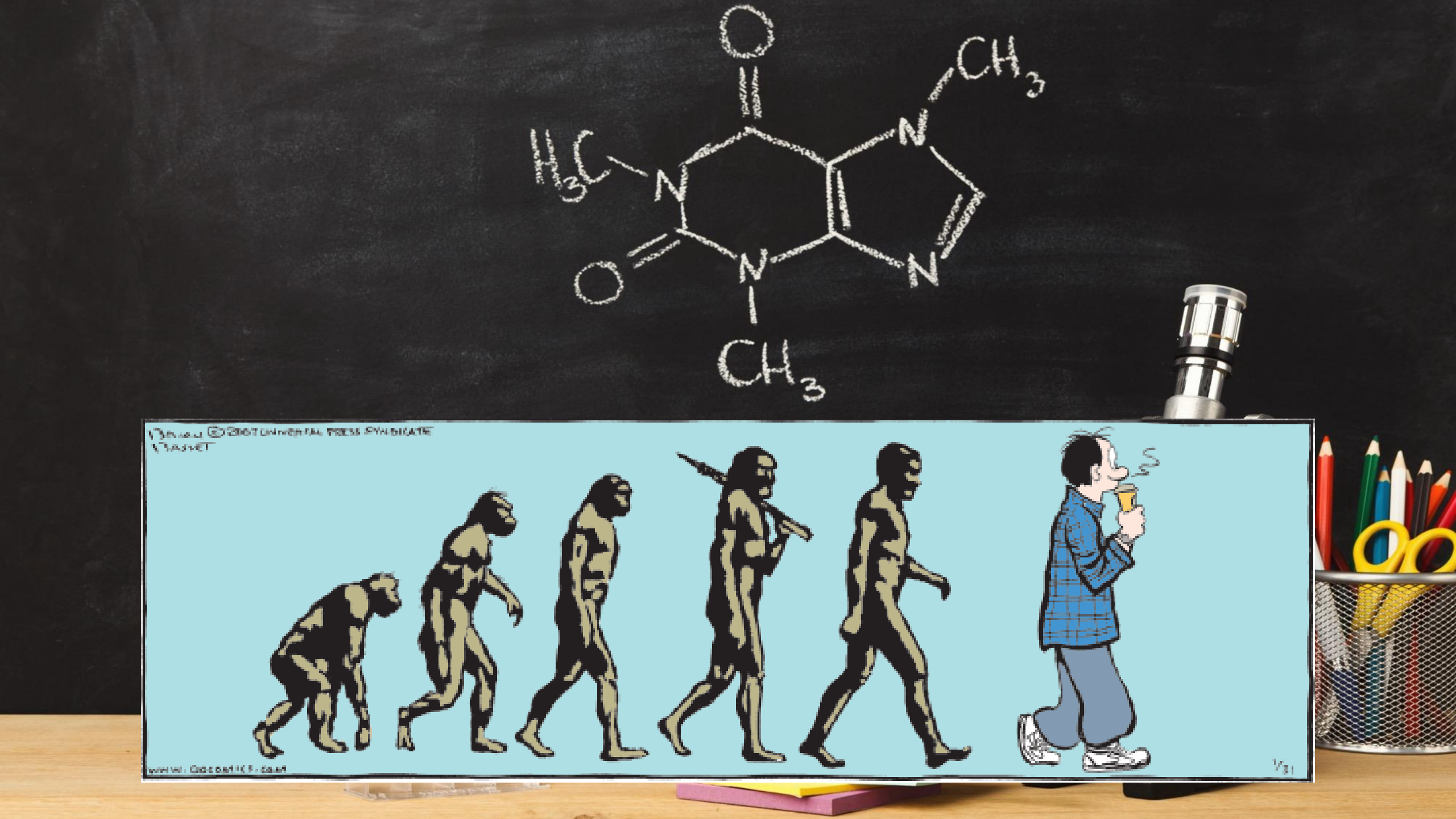
magnesium

melanoidins

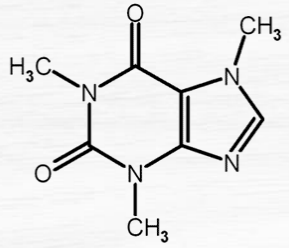
diterpenoids

polyphenols

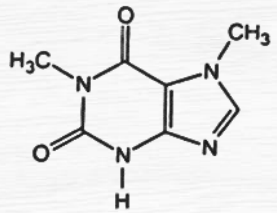
caffeine


O
CH3
H3C
N
N
N
N
O
CH3

Caffeine



CYP1A2



Paraxanthine

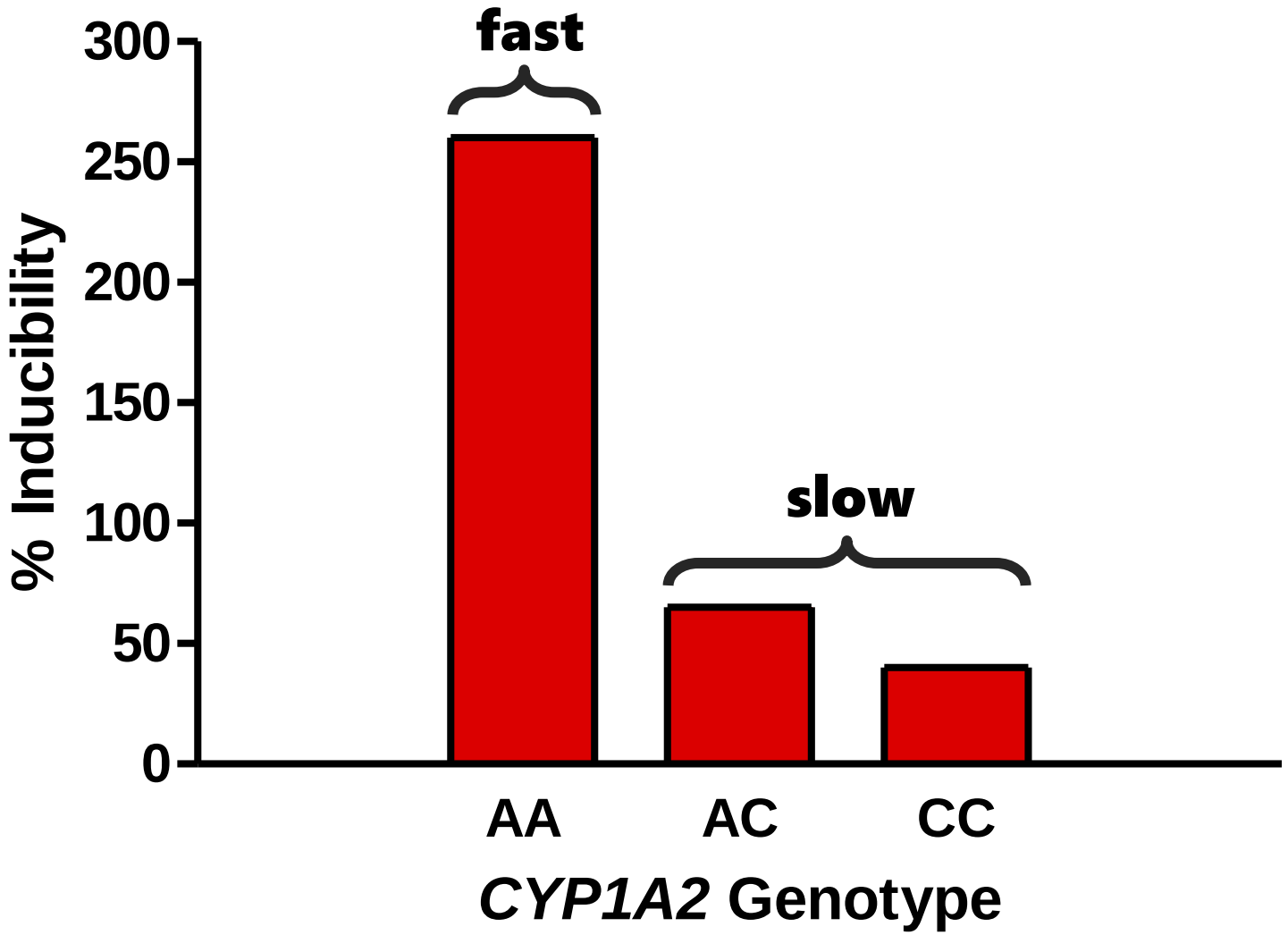
1,7-dimethyluric acid

1-methylxanthine

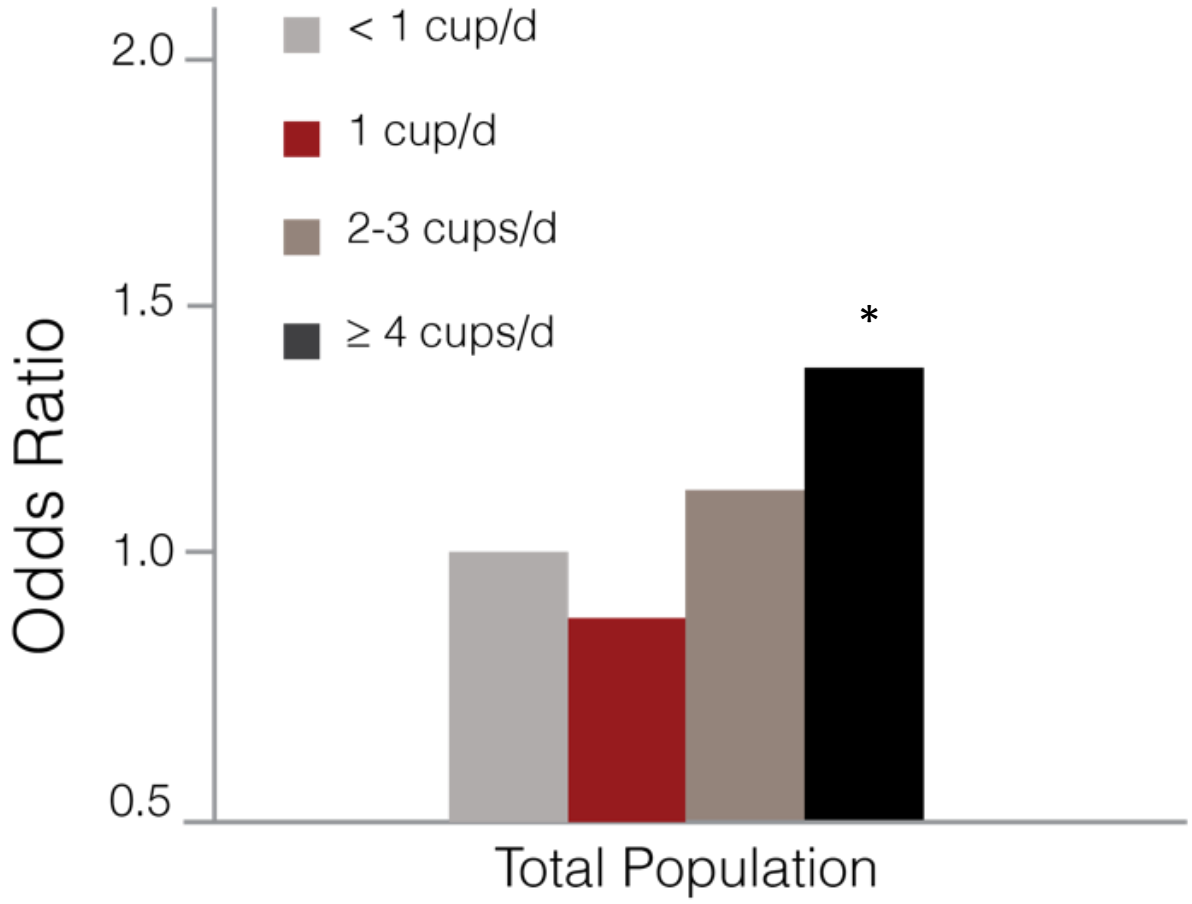
5-acetylamino-6-formylamino-3-methyluracil

1-methyluric acid

Genetic Variation in CYP1A2 (rs762551)



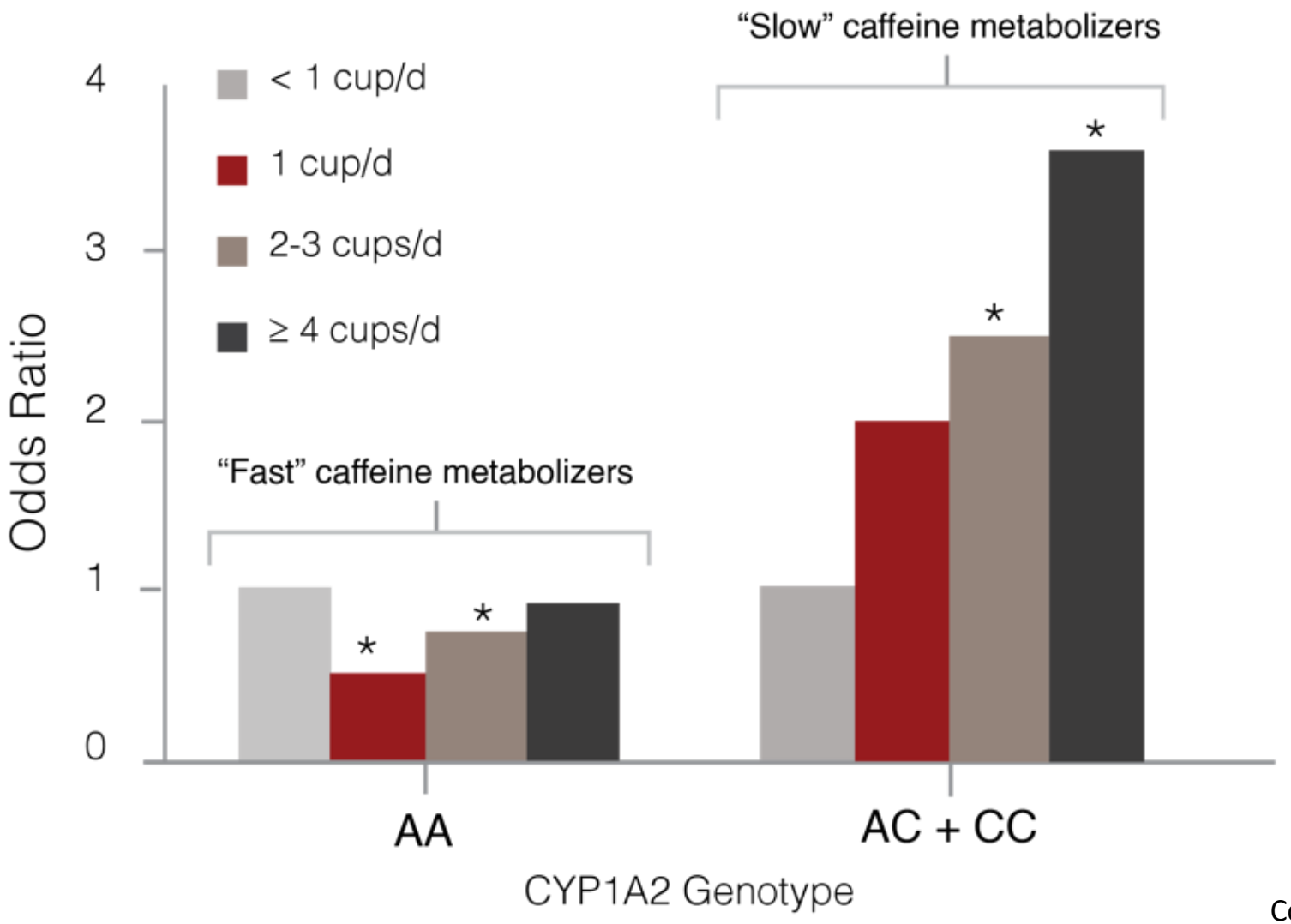
Coffee Intake & Risk of Myocardial Infarction



* P<0.05

Cornelis et al. JAMA. 2006;295:1135-41.

Coffee Intake, *CYP1A2* & Risk of Myocardial Infarction



Cornelis et al. JAMA. 2006;295:1135-41.

Coffee, CYP1A2 Genotype, and Risk of Myocardial Infarction

Marilyn C. Cornelis, BSc; Ahmed El-Sohemy, PhD; Edmond K. Kabagambe, PhD; et al

Article Information

JAMA. 2006;295(10):1135-1141. doi:10.1001/jama.295.10.1135

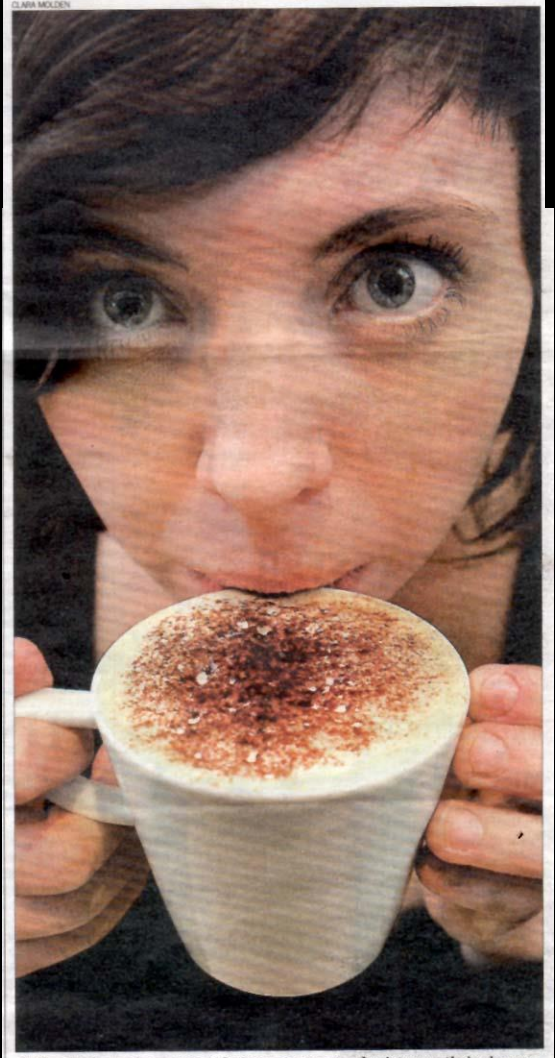
JAMA®
The Journal of the American Medical Association

THE TIMES 60p

No. 68643 ■ WEDNESDAY MARCH 8 2006 ■ NEWSPAPER OF THE YEAR

Why two cups of coffee can damage your heart

CLARA MOLDEN



Coffee drinkers who consume four or more cups a day increase their chances of having a heart attack by more than 60 per cent if they carry a variant gene, newly published research suggests. The risk for those who drink two to three cups a day was shown to be 36 per cent higher than normal NEWS page 11

THE TIMES 60p

No. 68643 ■ WEDNESDAY MARCH 8 2006 ■ NEWSPAPER OF THE YEAR

Gene that could make your next coffee your last

New research suggests that some people cannot process caffeine as quickly as others and may therefore be more vulnerable to a heart attack, **Sam Lister** reports

HELEN ATKINSON

High amounts of caffeine can be dangerous, but some doctors suggest coffee also has benefits

COFFEE drinkers who have more than three cups a day could significantly increase their chances of suffering a heart attack.

New research suggests that people who carry a particular variation of a gene cannot process caffeine as quickly as other people. Such individuals could be up to 64 per cent more likely to have a heart attack if they drink large amounts of coffee.

It is not known how common

long be a source of controversy, with high amounts of caffeine long blamed for over-stimulating the nervous system. It contains ditrepenes, said to be responsible for raising levels of a stress hormone called homocystine, which can lead to strokes.

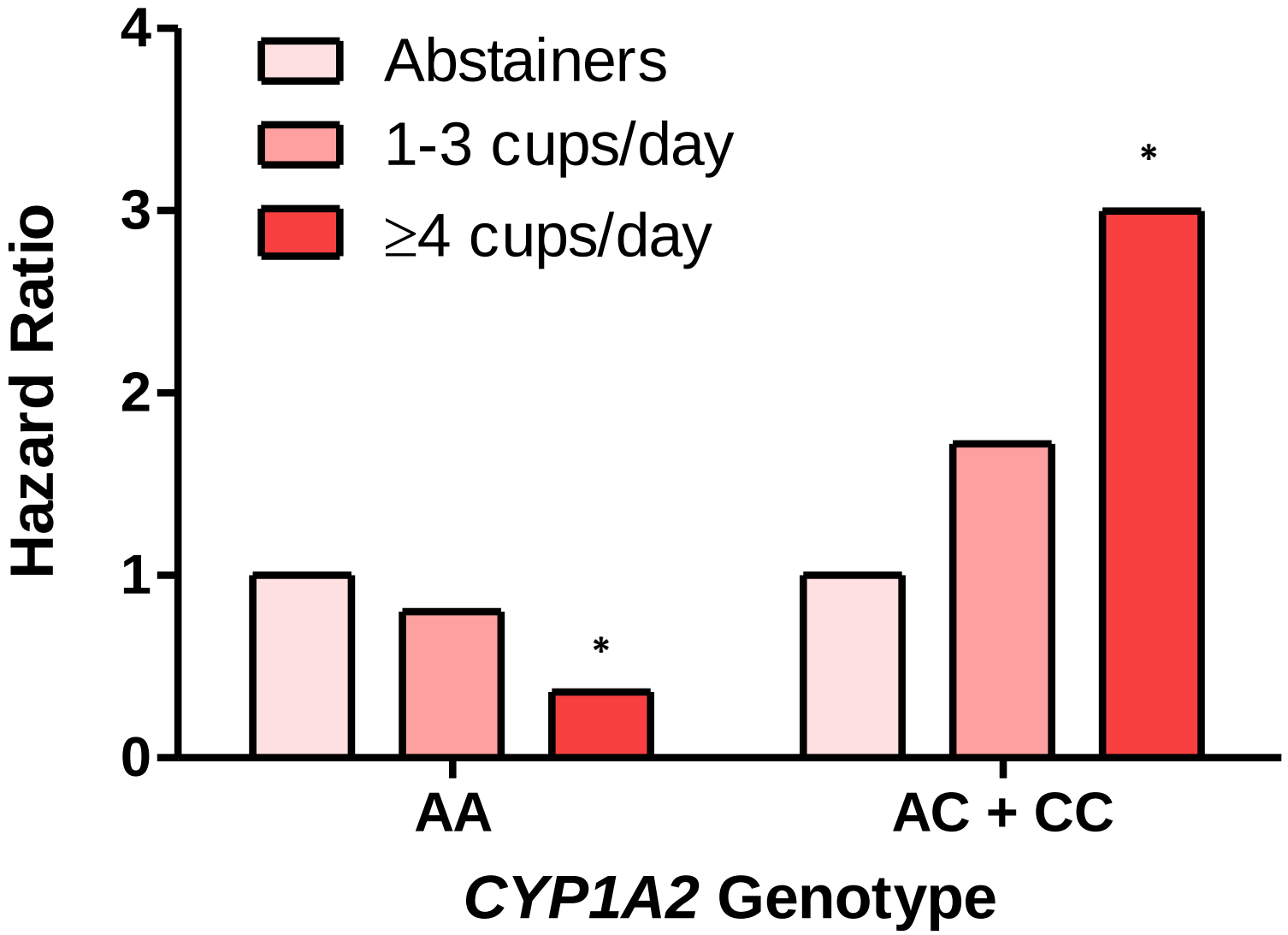
Pregnant women have been urged not to drink more than three cups of coffee a day in case it increases the chances of

Replication: Risk of Hypertension

CYP1A2 genotype modifies the association between coffee intake and the risk of hypertension

Paolo Palatini[a], Giulio Ceolotto[a], Fabio Ragazzo[a], Francesca Dorigatti[a], Francesca Saladini[a], Italia Papparella[a], Lucio Mos[b], Giuseppe Zanata[c] and Massimo Santonastaso[d]

Palatini *et al*., J Hypertens 27: 1594-1601, 2009



Coffee Intake and Risk of Hypertension

Replication: Risk of Pre-Diabetes

Eur J Epidemiol (2015) 30:209–217
DOI 10.1007/s10654-015-9990-z

CARDIOVASCULAR DISEASE

Association of coffee consumption and CYP1A2 polymorphism with risk of impaired fasting glucose in hypertensive patients

Paolo Palatini · Elisabetta Benetti · Lucio Mos · Guido Garavelli · Adriano Mazzer · Susanna Cozzio · Claudio Fania · Edoardo Casiglia

Replication: Elevated Blood Pressure

Vascular Pharmacology 106 (2018) 67–73

Contents lists available at ScienceDirect

Vascular Pharmacology

journal homepage: www.elsevier.com/locate/vph

The influence of CYP1A2 genotype in the blood pressure response to caffeine ingestion is affected by physical activity status and caffeine consumption level

Rogerio Nogueira Soares[a,*], Augusto Schneider[b], Sandra Costa Valle[b], Paulo Cavalheiro Schenkel[c]

[a] Faculty of Kinesiology, University of Calgary, 2500 University Dr NW, Calgary, AB T2N 1N4, Canada
[b] Faculty of Nutrition, Pelotas Federal University, Rua: Gomes Carneiro 1, Centro, 96010-610 Pelotas, Brazil
[c] Department of Physiology and Health Basic Science, Federal University of Rio Grande do Sul, Rua: Sarmento Leite, 500, 90050-170 Porto Alegre, Brazil

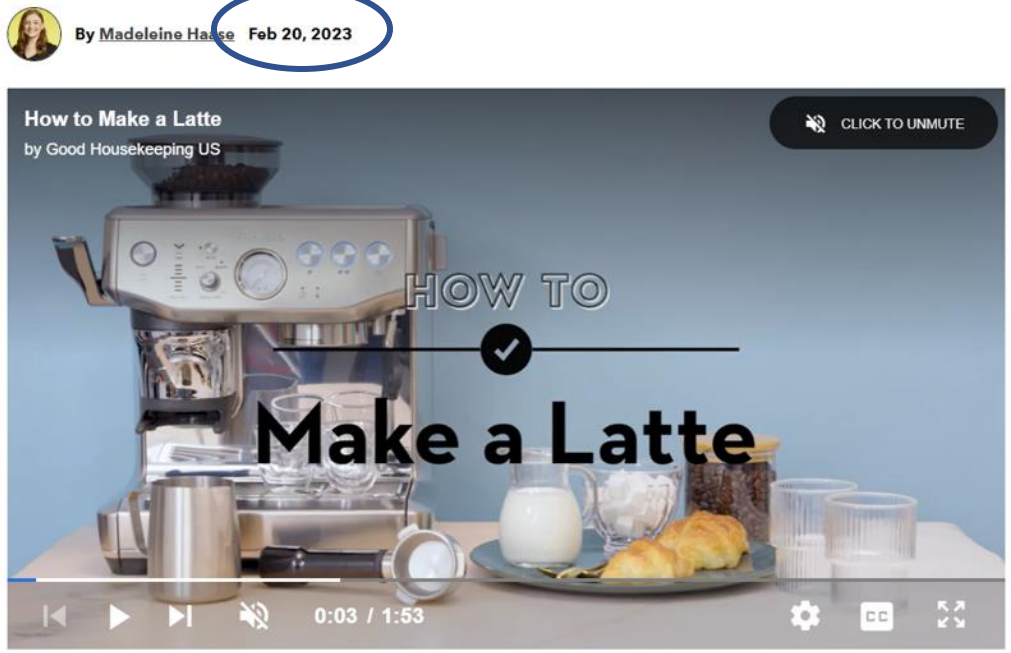
TORONTO | News

Some coffee drinkers could face kidney dysfunction if they don't reduce caffeine, new U of T research finds

Health

Drinking 3 Or More Cups of Coffee a Day May Increase Kidney Dysfunction Risk, Study Finds

Experts explain the new research which could affect half of the population.



By Madeleine Haase Feb 20, 2023

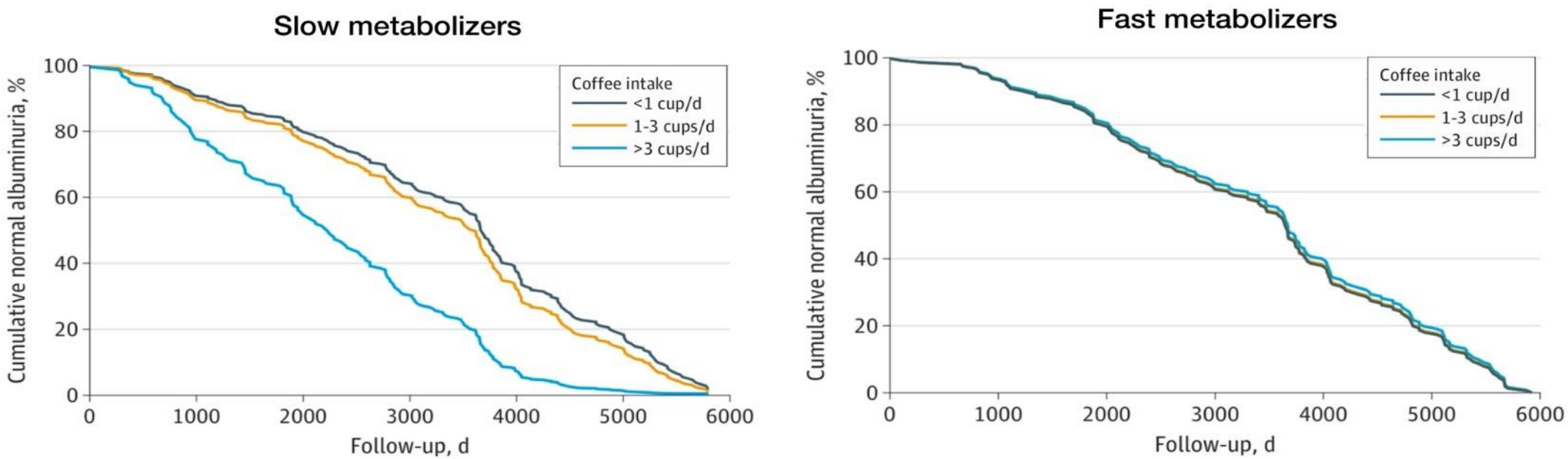
- *New research shows that some people may be at higher risk of kidney dysfunction when*

JAMA Network Open™

Original Investigation | Nephrology

CYP1A2 Genetic Variation, Coffee Intake, and Kidney Dysfunction

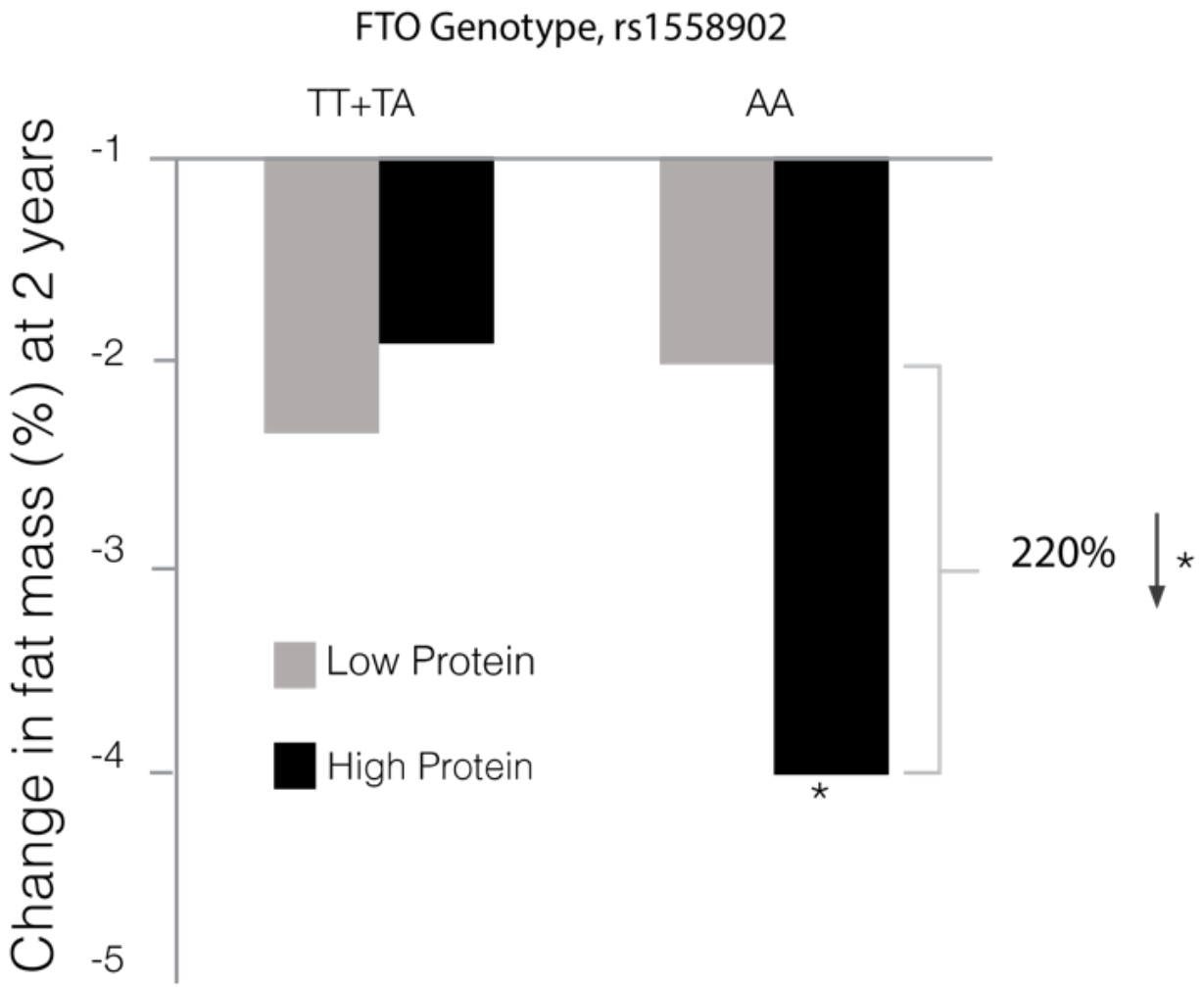
Sara Mahdavi, PhD; Paolo Palatini, MD; Ahmed El-Sohemy, PhD



JAMA Network Open. 2023;6(1):e2247868. doi:10.1001/jamanetworkopen.2022.47868

Weight Management

FTO, Protein & Weight Loss



Loss of fat mass after 2 years of low or high protein diet

Zhang et al. Diabetes. 2012;61:3005-3011.

Replication

Effects of a High-Protein/Low-Carbohydrate Diet versus a Standard Hypocaloric Diet on Weight and Cardiovascular Risk Factors: Role of a Genetic Variation in the rs9939609 *FTO* Gene Variant

Daniel Antonio de Luis Rocío Aller Olatz Izaola David Primo
Silvia Urdiales Enrique Romero

J Nutrigenet Nutrigenomics 2015;8:128–136

Replication

Merritt *et al. Genes & Nutrition* (2018) 13:4
https://doi.org/10.1186/s12263-018-0593-7

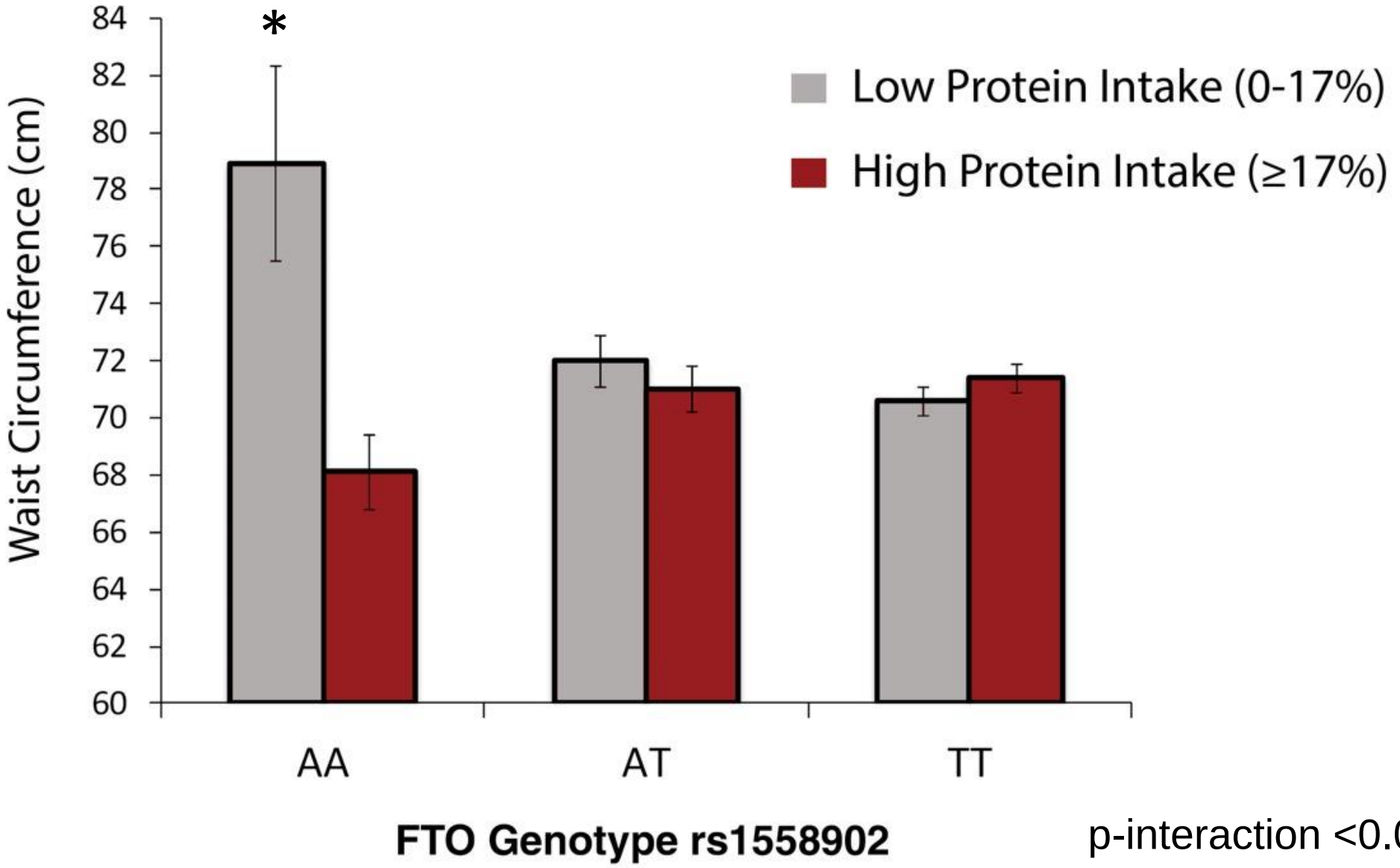
Genes & Nutrition

RESEARCH Open Access

FTO genotype, dietary protein intake, and body weight in a multiethnic population of young adults: a cross-sectional study

David C. Merritt[†], Joseph Jamnik[†] and Ahmed El-Sohemy[*]

East Asians



p-interaction <0.007

Replication

Antonio *et al. Journal of the International Society of Sports Nutrition* (2019) 16:36
https://doi.org/10.1186/s12970-019-0307-6

Journal of the International Society of Sports Nutrition

RESEARCH ARTICLE Open Access

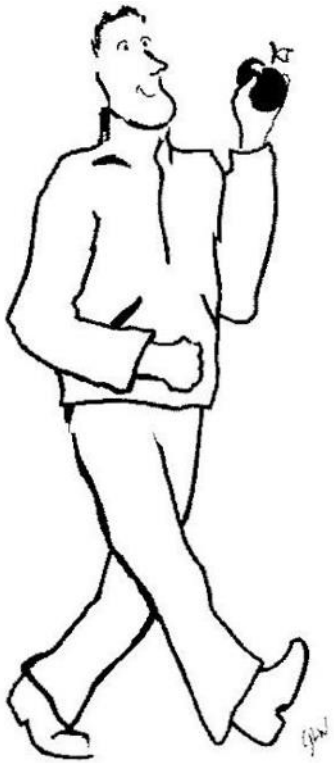
Check for updates

Assessment of the FTO gene polymorphisms (rs1421085, rs17817449 and rs9939609) in exercise-trained men and women: the effects of a 4-week hypocaloric diet

Jose Antonio[1*], Sarah Knafo[2], Madaline Kenyon[1], Alina Ali[2], Cassandra Carson[1], Anya Ellerbroek[1], Cailey Weaver[2], Justin Roberts[3], Corey A. Peacock[1] and Jaime L. Tartar[2]

Does genetic information influence behavior?

I have the gene,
so I eat healthily.



I have the gene,
so what can I do?

Does genetic information influence behavior?

DNA-based dietary advice resulted in:

- ✓ greater understanding of recommendations
- ✓ greater interest in learning more
- ✓ greater motivation to change eating habits

Genes Nutr (2012) 7:559–566
DOI 10.1007/s12263-012-0290-x

RESEARCH PAPER

A randomized trial of genetic information for personalized nutrition

Daiva E. Nielsen · Ahmed El-Sohemy

Does genetic information influence behavior?

DNA-based dietary advice resulted in:

- ✓ greater compliance after 1 year

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

PLOS ONE

Disclosure of Genetic Information and Change in Dietary Intake: A Randomized Controlled Trial

Daiva E. Nielsen, Ahmed El-Sohemy

Published: November 14, 2014 • https://doi.org/10.1371/journal.pone.0112665

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Cruel carer caught hitting disabled boy


Labour MP who lives in £3million

Argentina passes law stating that all


Three terror suspects appear at

Genes really do hold the key to fitting into your jeans: Diets personalised to our genetic makeup are far more effective, study finds

genomeweb

Business & Policy | Technology | Research | Clinical | Disease Areas | Applied Markets | Resource

Home » Clinical & Translational » Study Suggests Genetic Information May Lead to Behavioral Changes for Individuals with Sodium Sensi

Study Suggests Genetic Information May Lead to Behavioral Changes for Individuals with Sodium Sensitivity

Nov 14, 2014 | a GenomeWeb staff reporter

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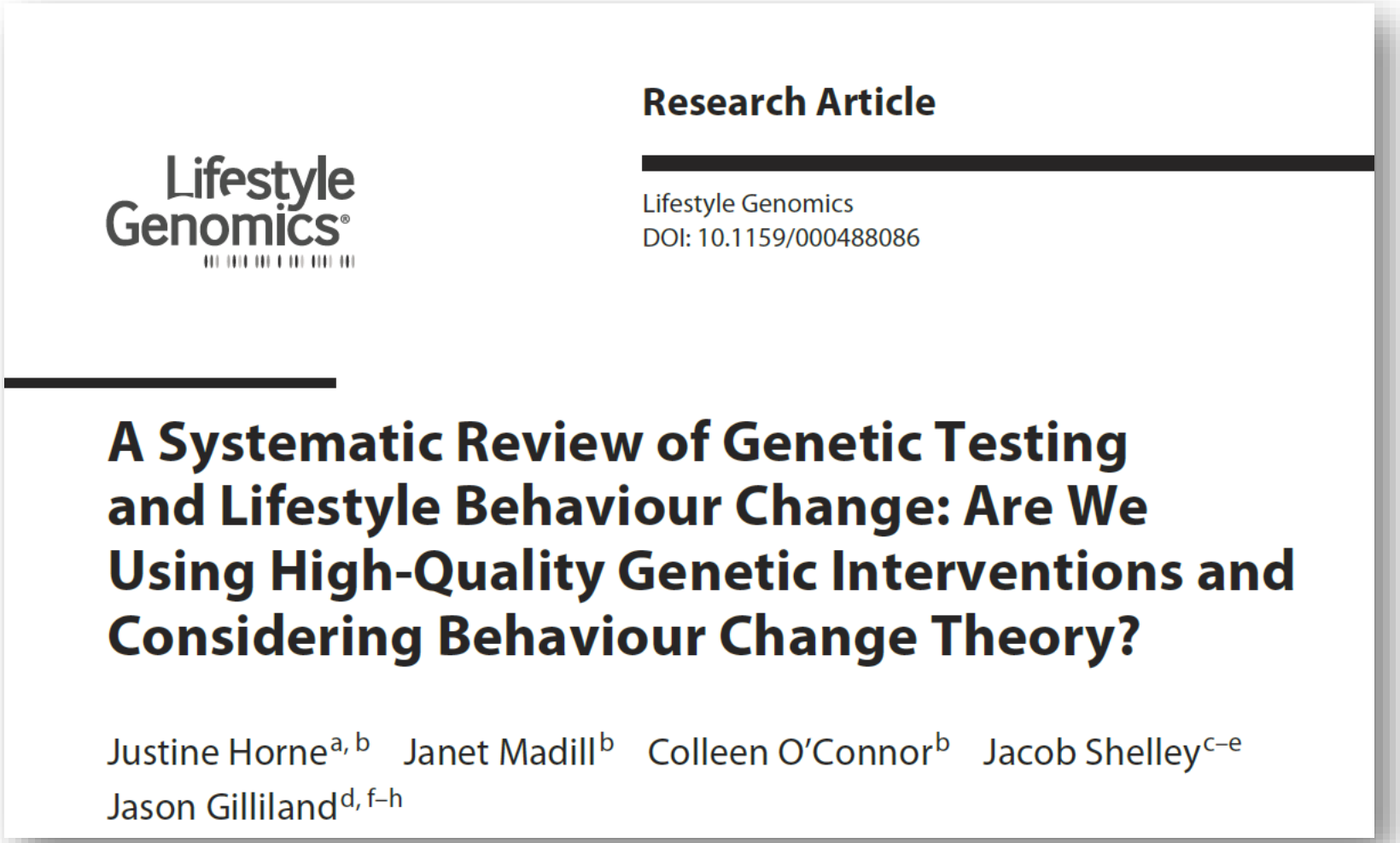
Genetic testing for personalized nutrition leads to better outcomes

18/11/2014 08:50:00

News | Physical Wellness | Mental Health | Science/T

HOME > PHYSICAL WELLNESS

DNA-Testing to Tailor Diets can be Effective, Study Reports



Research Article

Lifestyle Genomics

Lifestyle Genomics
DOI: 10.1159/000488086

A Systematic Review of Genetic Testing and Lifestyle Behaviour Change: Are We Using High-Quality Genetic Interventions and Considering Behaviour Change Theory?

Justine Horne[a, b] Janet Madill[b] Colleen O'Connor[b] Jacob Shelley[c–e]
Jason Gilliland[d, f–h]

Provision of actionable information is more likely to result in health behavior change

NOW TRIAL : June 2020

Open access Original research

BMJ Nutrition, Prevention & Health

Enhanced long-term dietary change and adherence in a nutrigenomics-guided lifestyle intervention compared to a population-based (GLB/DPP) lifestyle intervention for weight management: results from the NOW randomised controlled trial

To cite: Horne J, Gilliland J, O'Connor C, *et al*. Enhanced long-term dietary change and adherence in a nutrigenomics-guided lifestyle intervention compared to a population-based (GLB/DPP) lifestyle intervention for weight management: results from the NOW randomised controlled trial. *BMJ Nutrition, Prevention & Health* 2020;**0**. doi:10.1136/bmjnph-2020-000073

Justine Horne ,[1,2] Jason Gilliland,[3,4,5,6,7,8] Colleen O'Connor,[7,9] Jamie Seabrook,[3,6,7,8,9] Janet Madill[7,9]

Effects of Personalized Nutrition on Body Weight? – August 2020

Original Article
CLINICAL TRIALS AND INVESTIGATIONS

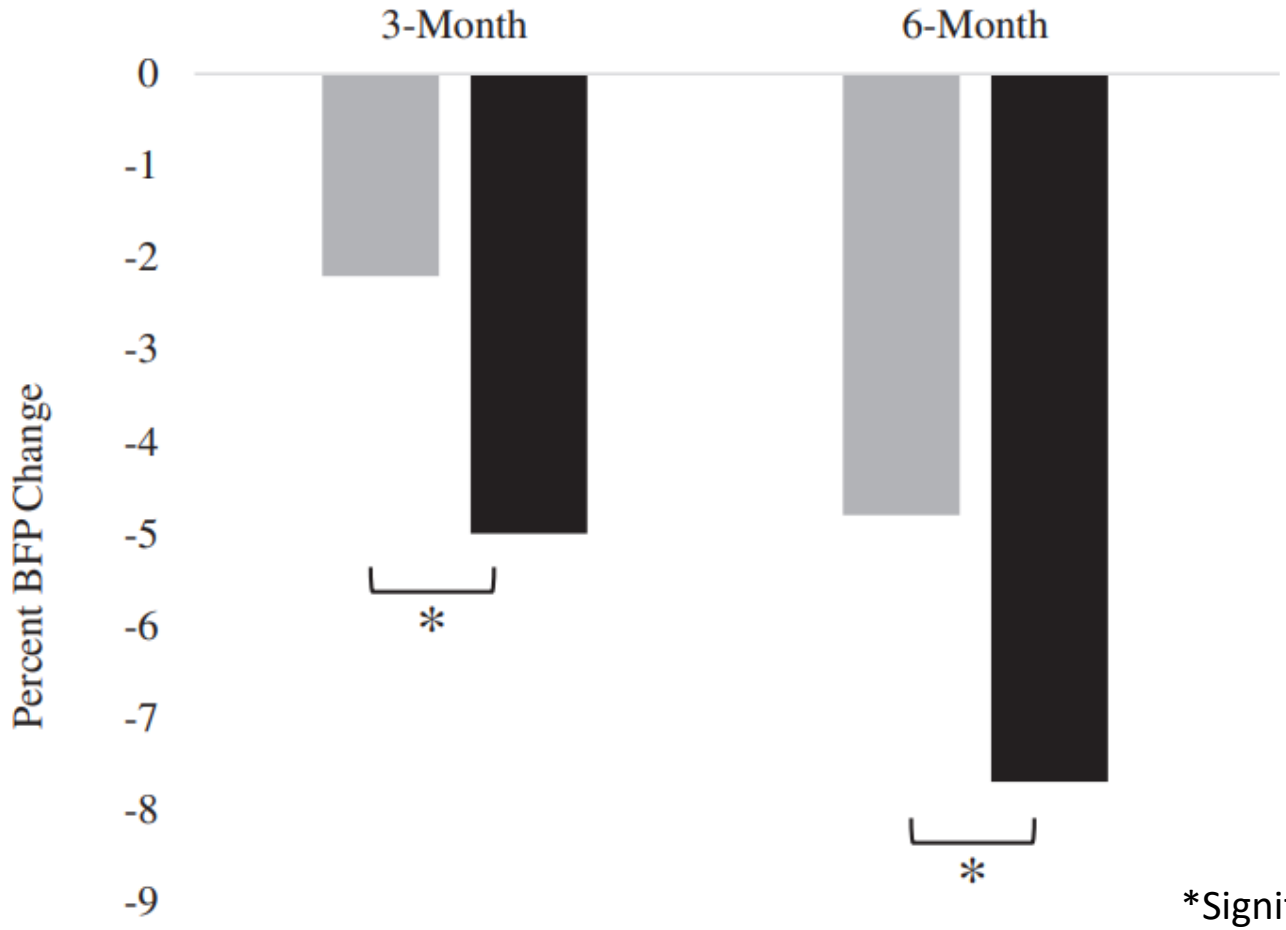
Obesity

Change in Weight, BMI, and Body Composition in a Population-Based Intervention Versus Genetic-Based Intervention: The NOW Trial

Justine R. Horne[1,2,3], Jason A. Gilliland[3,4,5,6,7,8,9], Colleen P. O'Connor[3,7,10], Jamie A. Seabrook[3,5,7,8,9,10], and Janet Madill[3,7,10]

 Received: 22 February 2020; **Accepted:** 30 April 2020; **Published online 22 July 2020. doi:10.1002/oby.22880**

Relative Change in Body Fat Percentage



DPP

DPP + Nutrigenomix

p-interaction = 0.003

*Significant difference between groups ($p<0.05$)

Adapted from Horne et al, Obesity 2020

Personalized advice elicited greater fat loss up to 6 months

DNA-based Dietary Advice Is Ready for Prime Time

Scientific evidence is robust (for some markers)

Independent of ethnic background

Improved compliance (evidence from RCT)

Information is actionable and “personalized”

Increasing consumer awareness and demand

How Nutrigenomix® Works

5 Step Process

Sample Collection

Send to the lab

Results Uploaded

Report Generated

Review Report

What makes Nutrigenomix® unique?

Scientific leadership

Research and Development

Targeted, action-oriented genetic markers

Privacy and security

Laboratory Standards

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PERSONALIZED NUTRITION & FITNESS REPORT

Sample Report – Summary of Results

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Vitamin A	BCMO1, rs11645428	GG	AA	Typical	Meet the RDA for vitamin A daily.
Vitamin B_{12}	FUT2, rs601338	GG or GA	GA	Elevated	Focus on consuming bioavailable sources of vitamin B12.
Vitamin C	GSTT1, rs2266633	Del	Ins	Typical	Meet the RDA for vitamin C daily.
Vitamin D	CYP2R1, rs10741657	Algorithm	AA	Elevated	Consume 1000 IU (25 mcg) vitamin D daily.
	GC, rs2282679		GG		

Vitamin D

Vitamin D is essential to calcium metabolism and promotes calcium absorption in the gut. Low levels of vitamin D are associated with decreased bone mineral density and an increased risk of fractures. Vitamin D also contributes to normal functions of most cells in the body. Vitamin D can be synthesized by the skin from UV light or it can be obtained from the diet. Low blood levels of vitamin D can result in weak, brittle bones, poor muscle function, and decreased immunity. Life-long vitamin D insufficiency has also been linked to accelerated cognitive decline, autoimmune disorders, neuro-degenerative diseases and cardiovascular disease. Vitamin D deficiency is diagnosed by measuring the most common form of vitamin D in the blood, which is 25-hydroxyvitamin D. Research shows that variations in the CYP2R1 and GC genes can affect your risk for low circulating 25-hydroxyvitamin D levels.*

*Slater NA et al. Genetic Variation in CYP2R1 and GC Genes Associated With Vitamin D Deficiency Status. Journal of Pharmacy Practice. 2015;1-6.
Wang TJ et al. Common genetic determinants of vitamin D insufficiency: a genome-wide association study. Lancet. 2010;376:180-88.

CYP2R1 & GC

Vitamin D 25-hydroxylase is the key enzyme that activates vitamin D from its pre-formed type, which is obtained through sun exposure and the diet. This enzyme is encoded by the CYP2R1 gene and a variant of this gene has been associated with an increased risk of low circulating levels of vitamin D. The GC gene encodes the vitamin D-binding protein, which binds vitamin D and transports it to tissues. A variant in this gene has also been associated with an increased risk of low circulating levels of vitamin D.

Sources of Vitamin D

	Amount (IU)
Sockeye salmon (75g)	680
Whitefish (75g)	448
Sardines, canned in oil (1/2 can)	254
Rainbow trout (75g)	192
Smoked salmon (40g)	168
Halibut (75g)	144
Fortified plant-based beverage (1 cup)	124
Arctic char (75g)	112
Milk (1 cup)	104
Orange juice, fortified with vitamin D (1/2 cup)	50

Source: Health Canada's Nutrient Value of Some Common Foods and Canadian Nutrient File

6in7
People with Risk Variant(s)

Your Results

Genes	Markers
CYP2R1 GC	rs10741657 rs2282679
Risk Variant	**Your Variants**
Algorithm	GA GG

Your Risk

Elevated
only when vitamin D intake is low

Recommendation

Since you possess one or more elevated risk variants, you are at an increased risk for low circulating vitamin D levels, so getting enough vitamin D is important. Aim for 1000 IU (25 mcg) vitamin D per day. This can help to maintain and/or improve your bone health, muscle and brain function, immunity, and heart health. Since it may be challenging to get enough vitamin D in the diet, supplementation may be beneficial. Do not exceed 2000 IU (50 mcg) per day without first having your blood levels of vitamin D assessed and monitored by a healthcare professional.

Consume 1000 IU (25 mcg) vitamin D daily.

As easy as the 5 W's

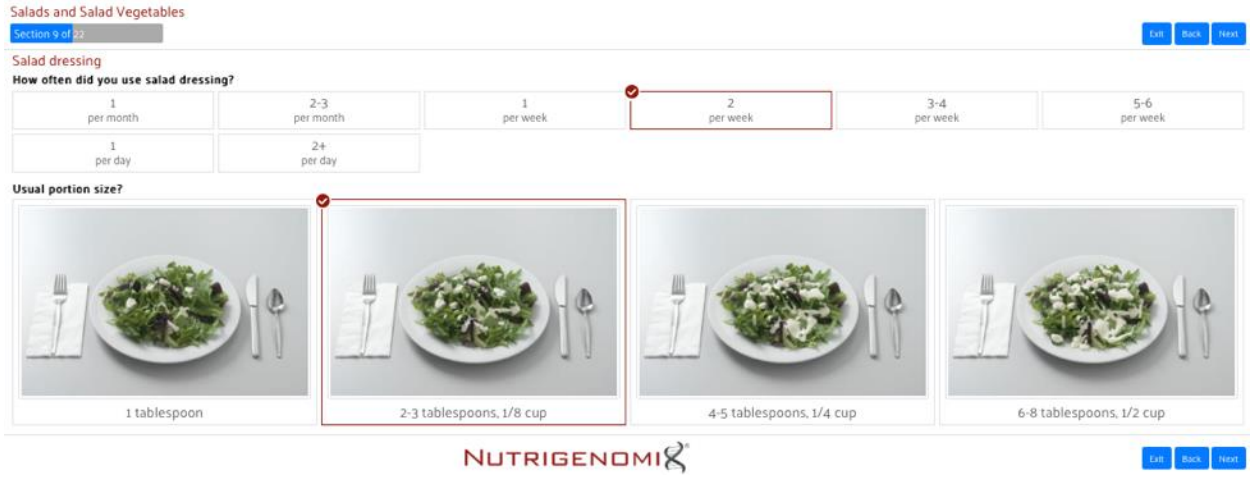
- What?
- Why?
- Where?
- Who designs my meal plan?
- When can I start?

NUTRIGENOMIX®

77-gene Test

Plus Additional Genetic Insights including insights on Inflammation, Antioxidant Capacity, Sleep and Hormone Metabolism & Methylation.

Only genetic test to incorporate a validated dietary assessment questionnaire/
food frequency questionnaire (FFQ).

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"Positive health requires a knowledge of man's **primary constitution** and of the powers of various foods, both those natural to them and those resulting from **human skill**."

Personalized nutrition

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Q&A

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