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**NUTRIGENOMIX**

Precision Nutrition:  
*Recent advances and controversies in genetic testing*

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**Disclosures**

A.E-S. is a Professor at the University of Toronto

 Nutritional Sciences  
 UNIVERSITY OF TORONTO

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



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**Diet** ↔ **Genes**  
 ↑  
 FOOD PREFERENCES

**The Science of NUTRIGENOMICS**  
 using genetic testing to determine why individuals respond differently to the same foods, beverages and supplements they consume.

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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. Eay,<sup>1</sup> Thomas M. S. Wolever,<sup>1,2</sup> Bénédicte Fontaine-Bisson,<sup>1</sup> and Ahmed El-Sohemy<sup>1</sup>  
<sup>1</sup>Department of Nutritional Sciences, University of Toronto; and <sup>2</sup>St. Michael's Hospital, Toronto, Canada  
 Submitted 10 July 2007; accepted in final form 14 March 2008.

Ile → | Sugar intake      Thr → | Sugar intake

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**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

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**The Science of Nutrigenomics**

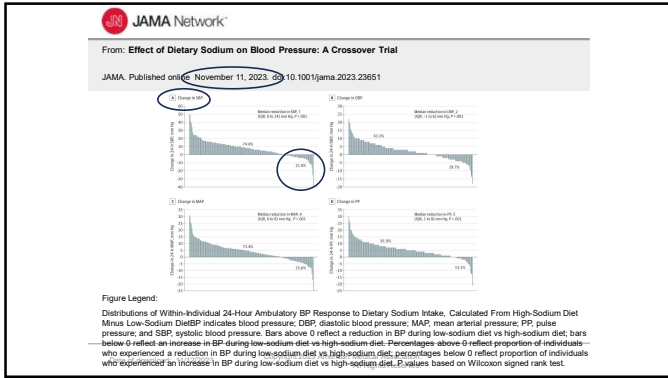
Nutrition → Health Outcome

Genes →

- Genotype A → Increase
- Genotype B → No Effect
- Genotype C → Decrease

**One size does not fit all**

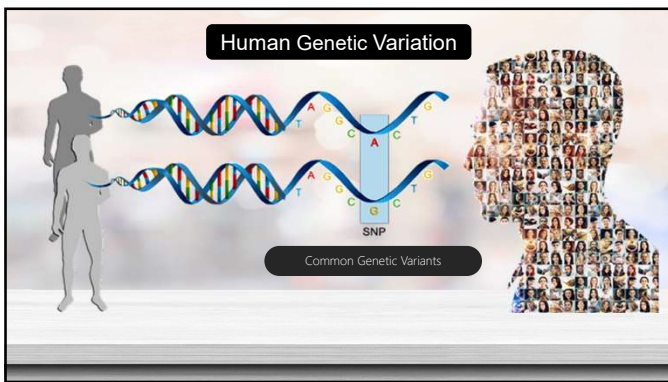
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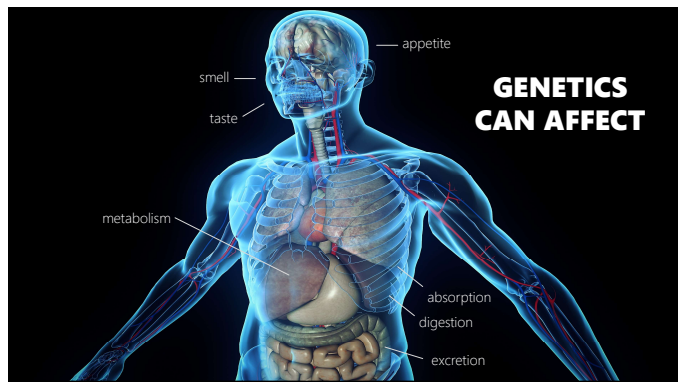
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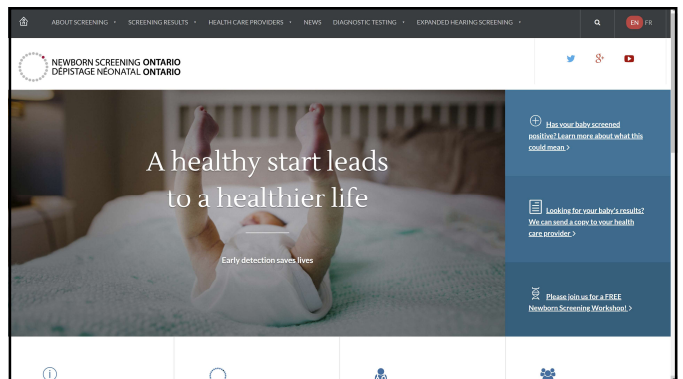
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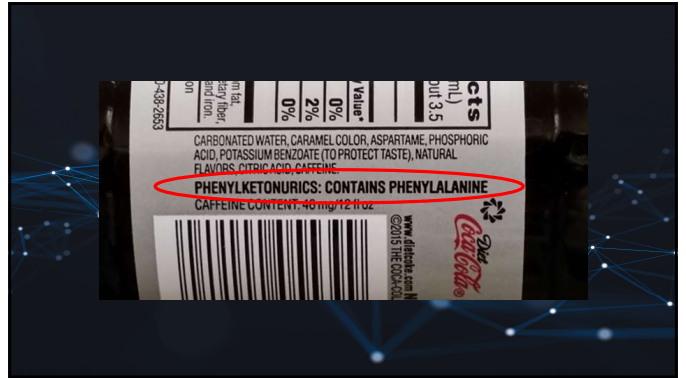
NEWBORN SCREENING ONTARIO  
DERIVATIVE NEONATAL ONTARIO

## 26 diseases tested

70% are managed by diet

- Argininosuccinic Acid Lyase Deficiency (ASA)
- Biotinidase Deficiency
- Carnitine Uptake Defect (CUD)
- Citrullinemia
- Cobalamin A & B Defects
- Congenital Adrenal Hyperplasia (CAH)
- Congenital Hypothyroidism (CH)
- Critical Congenital Heart Disease (CCHD)
- Cystic Fibrosis (CF)
- Galactosemia
- Glutamic Acidemia Type 1 (GA1)
- Homocystinuria
- Isovaleric Acidemia (IVA)
- Long Chain 3-Hydroxyacyl-CoA Dehydrogenase Deficiency (LCHAD)
- Maple Syrup Urine Disease (MSUD)
- Medium Chain Acyl CoA Dehydrogenase Deficiency (MCADD)
- Phenylketonuria (PKU)
- Propionic Acidemia (PA)
- Severe Combined Immune Deficiency (SCID)
- Sickle Cell Disease (Hemoglobin SC)
- Sickle Cell Disease (Hemoglobin SS)
- Sickle Cell Disease (Sickle/Beta-Thalassemia)
- Trifunctional Protein Deficiency (TFP)
- Tyrosinemia Type I
- Very Long Chain Acyl CoA Dehydrogenase Deficiency (VLCAD)

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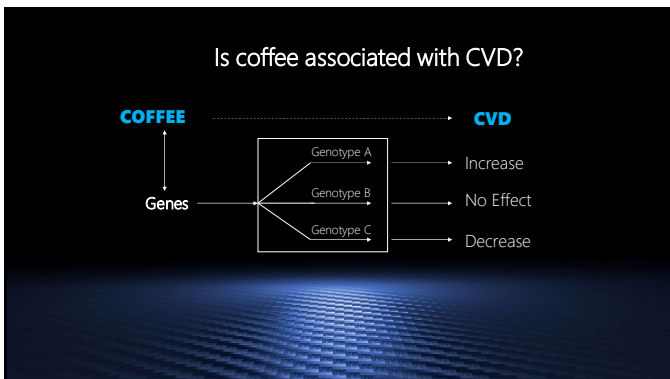
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**Cardiometabolic disease** is the #1 cause of death and disability among US adults

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

~50% of cardiometabolic deaths are attributable to poor diet

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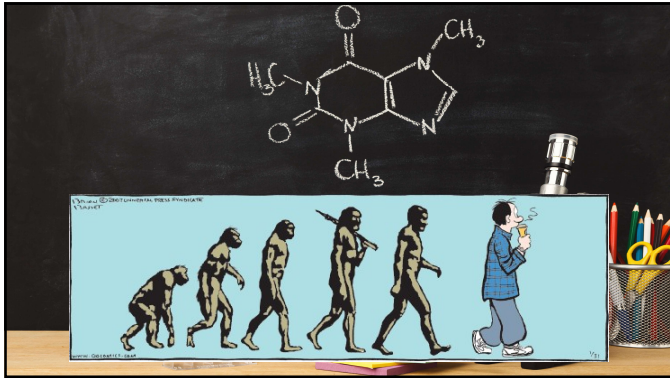
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## Bioactives in Coffee

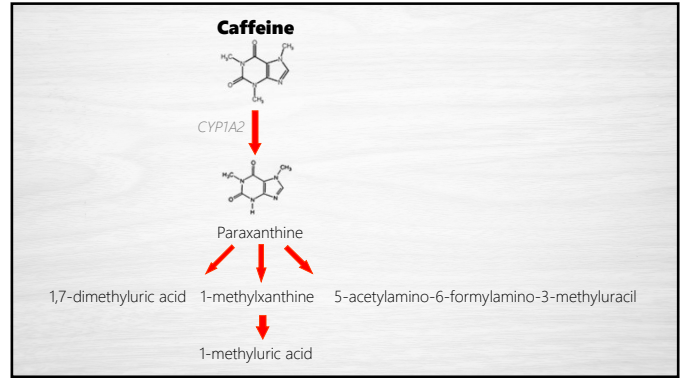
- aliphatic acids
- potassium
- magnesium
- melanoidins
- diterpenoids
- polyphenols
- caffeine**

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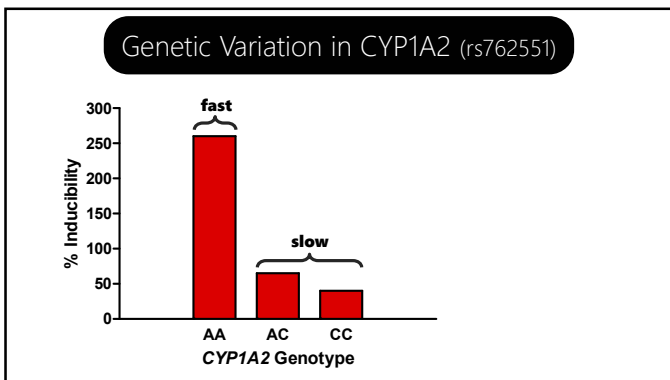




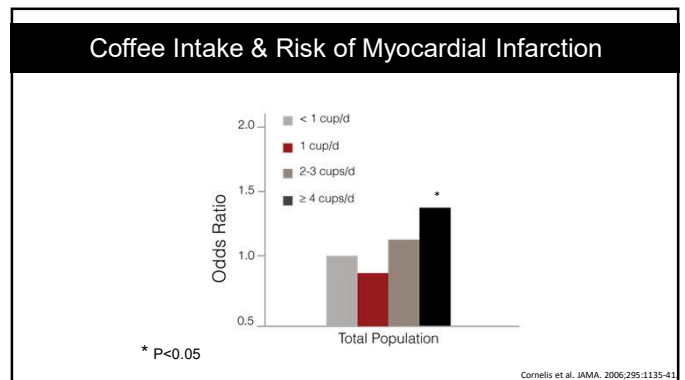
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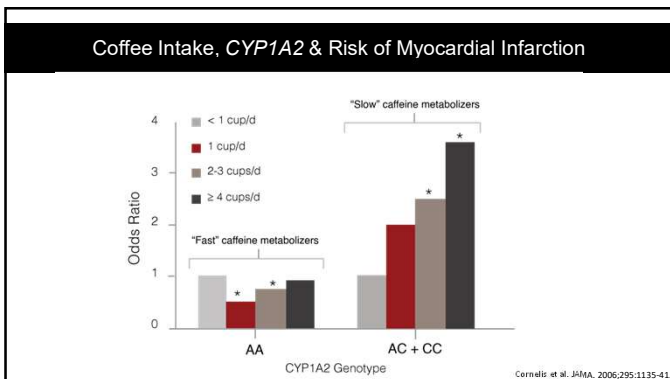
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**Coffee, CYP1A2 Genotype, and Risk of Myocardial Infarction**

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

Article Information

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

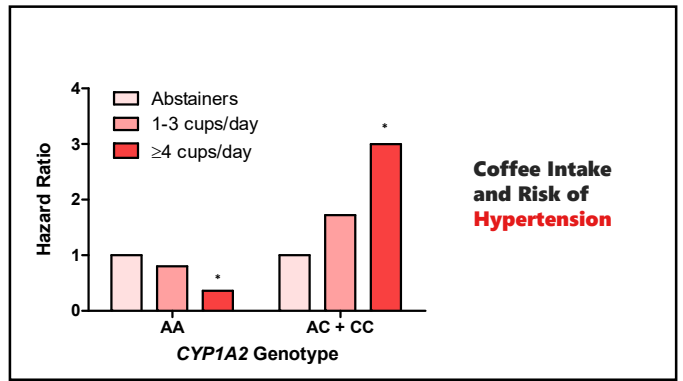
**JAMA**  
The Journal of the American Medical Association

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**Replication: Risk of Hypertension**

**CYP1A2 genotype modifies the association between coffee intake and the risk of hypertension**  
 Paolo Palatini<sup>a</sup>, Giulio Geolotto<sup>a</sup>, Fabio Ragazzo<sup>b</sup>, Francesca Dorigatti<sup>a</sup>,  
 Francesca Saladini<sup>a</sup>, Italia Papparella<sup>a</sup>, Lucio Mos<sup>b</sup>, Giuseppe Zanata<sup>b</sup> and  
 Massimo Santonastaso<sup>a</sup>  
 Palatini et al., J Hypertens 27: 1594-1601, 2009.

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**Replication: Risk of Pre-Diabetes**

Int J Epidemiol (2013) 42:209-217  
 DOI: 10.1093/ije/dys399

**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 Fanla · Edoardo Casiglia

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**Replication: Elevated Blood Pressure**

Vascular Pharmacology 19K (2015) 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  
 Rogério Nogueira Soares<sup>a,\*</sup>, Augusto Schneider<sup>b</sup>, Sandra Costa Valle<sup>b</sup>, Paulo Cavalheiro Schenkel<sup>c</sup>

<sup>a</sup> Faculty of Kinesiology, University of Calgary, 2500 University Dr NW, Calgary, AB T2N 1N4, Canada  
<sup>b</sup> Faculty of Nursing, Federal Rural University, Rua General Carneiro, 1, Centro, 46201-900 Patos, Brazil  
<sup>c</sup> Department of Physiology and Health Basic Science, Federal University of Rio Grande do Sul, Rua Sarney Filho, 500, 91505-170 Porto Alegre, Brazil

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

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**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 Michael Levenson | FEB 20, 2023

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**Replication**

Antonio et al. *Journal of the International Society of Sports Nutrition* (2016) 16:36  
<https://doi.org/10.1186/s12970-016-0307-6> Journal of the International Society of Sports Nutrition

**RESEARCH ARTICLE** Open Access

**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<sup>1</sup>, Sarah Krulic<sup>2</sup>, Madeline Kenyon<sup>1</sup>, Alina Ali<sup>2</sup>, Cassandra Carson<sup>1</sup>, Anya Elberts<sup>3</sup>, Casley Weaver<sup>4</sup>, Justin Roberts<sup>5</sup>, Corey A. Peacock<sup>1</sup> and Jaime L. Tartar<sup>6</sup>




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**Does genetic information influence behavior?**

*I have the gene, so I eat healthily.*



*I have the gene, so what can I do?*



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**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

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**Does genetic information influence behavior?**

DNA-based dietary advice resulted in:

- ✓ greater compliance after 1 year

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE



**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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**Research Article**

Lifestyle Genomics  
 LIFESTYLE GENOMICS

Lifestyle Genomics  
 DOI: 10.1155/200488086

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

Justine Horne<sup>a,b</sup>, Janet Madill<sup>b</sup>, Colleen O'Connor<sup>b</sup>, Jacob Shelley<sup>c-e</sup>, Jason Gilliland<sup>d, f-h</sup>

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

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**NOW TRIAL : June 2020**

Open access Original research

**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;8. doi:10.1136/bmjnp-2020-000073


Justine Horne<sup>1,2</sup>, Jason Gilliland<sup>3,4,5,6,7,8</sup>, Colleen O'Connor<sup>7,8</sup>, Jamie Seabrook<sup>3,6,7,8</sup>, Janet Madill<sup>7,8</sup>

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### Sample Report



**Your Results**

Gene	Methionine
FTO	rs9939609
Response Variant	Your Variant
AA	AA

Your Disposition: **Enhanced**

**Recommendation**

Since you have the AA variant of the FTO gene, you have an enhanced weight loss response from consuming a moderate-to-high protein diet. A moderate-to-high protein diet can be beneficial since it can help you lose fat mass, enhance weight loss, and improve your body composition. It can also help with long-term improvements to body fat distribution and increase your chances of long-term weight loss. Aim to consume 25-35% of energy from protein as part of a controlled energy diet.

Consume 25-35% of energy from protein.

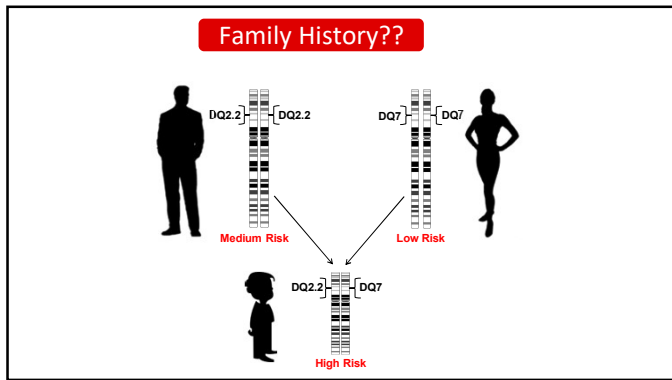
\* Prepared by Nutrigenomix Inc.

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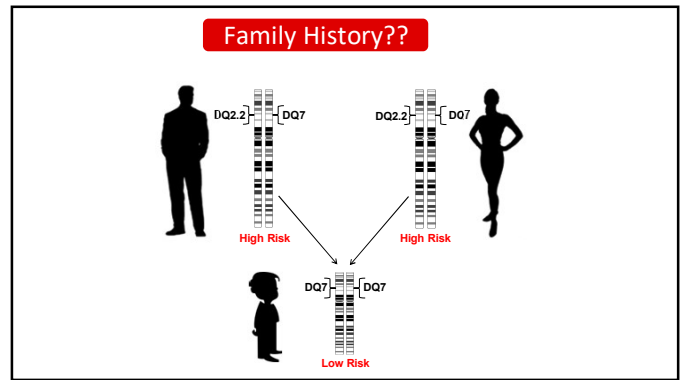
### What the skeptics say...which is false

- Single SNPs are useless.
- People won't change their behaviours.
- We need more evidence. From RCTs.
- It's the microbiome
- Results from genetic tests are too complex.
- Family history is more informative

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### What the skeptics say...which is false

- Single SNPs are useless.
- People won't change their behaviours.
- We need more evidence. From RCTs.
- It's the microbiome
- Results from genetic tests are too complex.
- Family history is more informative
- Just follow recommendations for healthy eating

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**IT'S YOUR HEALTH**

**Caffeine**

**The Issue**

Caffeine is a natural and added source found in a growing list of products including coffee, tea, soda, chocolate and even some medicines. The increasing presence of caffeine in our lives raises the question of how much is too much for the average consumer.

**The Health Effects of Caffeine**

It is difficult to keep precise intake levels of caffeine to specific health effects because tolerance to caffeine differs widely from person to person. For healthy adults, a small amount of caffeine may have positive effects, such as increased alertness or ability to...

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## Where are we today?

- We need to eat.....today.
- We currently give dietary advice for healthy eating.
- Current recommendations are based on (old) science.
- How much more evidence do we need?

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## Benefits of Genetic Testing

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



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### 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

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2007

### Genetics may define diets of the future

By Carrie Peyton Dahlberg  
*SEATTLE 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 continue well. ▶ GENETICS, Page A10

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2017

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The Billion Dollar Mystery Man and the Wildest Perry Veggie...

**LIFE**  
What Consumers Should Know About Commercial DNA...

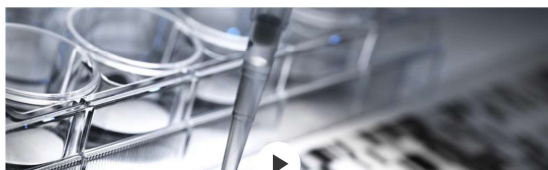
**BUSINESS**  
Gold's Gym's Biggest Secret: Streaming TV Prices Are Marching Righter

**OPINION**  
Opinion: Carbs, Good for Your Fat Class?

HEALTH | YOUR HEALTH


### Test Your Genes to Find Your Best Diet

Genetic testing can reveal what nutrients you're missing and if you're drinking too much coffee



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480BC



genotype

"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

Hippocrates

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Q&A



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