



# The True Purpose Of Nutrition

**Robert H. Lustig,  
MD, MSL**



Integrated and Personalized Medicine Congress, July 1, 2023

## Blueprint

Blueprint Starter Guide

By The Numbers

Step 1: Meal Prep

Step 2: Supplements

Step 3: Measurements

Bryan Johnson's Blueprint

Current Results

Routine Measurement

Heart / Brain / Lung

Gastrointestinal

Hair / Skin / Eye / Ear

Oral / Sleep / Other

Diet / Supplements

Fitness

Notable Challenges

Appendix

Latest Photos

FAQ

[Archived] Monthly Notes

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# Be the next evolution of human

## MY RESULTS FROM 2 YRS OF BLUEPRINT:

- + 5.1 yrs epigenetic age reversal (world record)
- + slowed my pace of aging by 24%
- + perfect muscle & fat (MRI)
- + 50+ perfect biomarkers
- + 100+ markers < chronological age
- + fitness tests = 18yr old
- + body runs 3F° cooler





# NEW YORK

**Bon Appétit.**



So many people  
(and half of Hollywood)  
are suddenly thinner,  
having swapped their old  
diets for a dose of the  
diabetes drug **Ozempic**.

BY MATTHEW SCHNEIER

# Axioms

- You can't fix healthcare until you fix health
- You can't fix health until you fix diet
- And you can't fix diet until you know what's wrong

# Definitions

- **Food Science:** What happens between the ground and the mouth
- **Nutrition:** What happens between the mouth and the cell
- **Metabolic Health:** What happens inside the cell

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- **Nutrition:** What happens between the mouth and the cell
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**IT'S ONLY WHAT HAPPENS INSIDE THE CELL  
THAT LEADS TO DISEASE**

***Consultative Brief – March 2023***

## **New Frontiers of Nutrition**

*Evolved science-based insights from global nutrition experts to inform food system/transformation.*

*Consultative Brief – March 2023*

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# **The True Purpose Of Nutrition: METABOLIC HEALTH**

*Consultative Brief – March 2023*

## **New Frontiers of Nutrition**

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# **The True Purpose Of Nutrition: METABOLIC HEALTH**

***OK, what is that?***



# The Hateful (or Grateful) Eight

The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging





# The Hateful (or Grateful) Eight

The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging



- 1. Glycation (carbon deposits)





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- 2. Oxidative Stress (rusting)





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- 7. Methylation (spark plugs)
- 8. Autophagy (oil sludge)





# The Hateful (or Grateful) Eight

The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging



- 1. Glycation ---- **carbohydrate, fructose, lack of fiber**
- 2. Oxidative Stress ---- **glucose, fructose, trans-fats**
- 3. Mitochondrial Dysfunction --- **fructose, omega-6's, trans-fats, lack of micronutrients**
- 4. Insulin Resistance --- **fructose, branched chain amino acids**
- 5. Membrane Integrity --- **lack of omega-3's**
- 6. Inflammation ---- **carbohydrate/gluten (in some), omega-6s, fructose, lack of fiber**
- 7. Methylation --- **lack of folic acid, B<sub>6</sub>, B<sub>12</sub>**
- 8. Autophagy --- **frequent feeding, lack of fiber**

*None of these are “druggable”  
But they are all “foodable”*



# The Hateful (or Grateful) Eight

The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging



- 1. Glycation ---- NOT amenable to exercise
- 2. Oxidative Stress ---- NOT amenable to exercise
- 3. Mitochondrial Dysfunction
- 4. Insulin Resistance
- 5. Membrane Integrity ---- NOT amenable to exercise
- 6. Inflammation
- 7. Methylation ---- NOT amenable to exercise
- 8. Autophagy

*“You can't outrun a bad diet”*

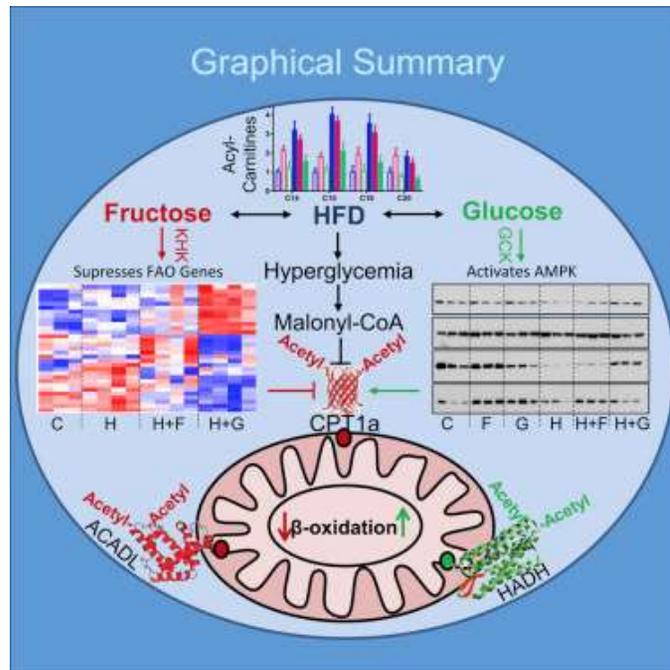
# **The goal: Metabolic Health**

## **The Strategies:**

- **Promote Metabolism**
- **Inhibit Inflammation**

## Fructose inhibits mitochondrial functioning

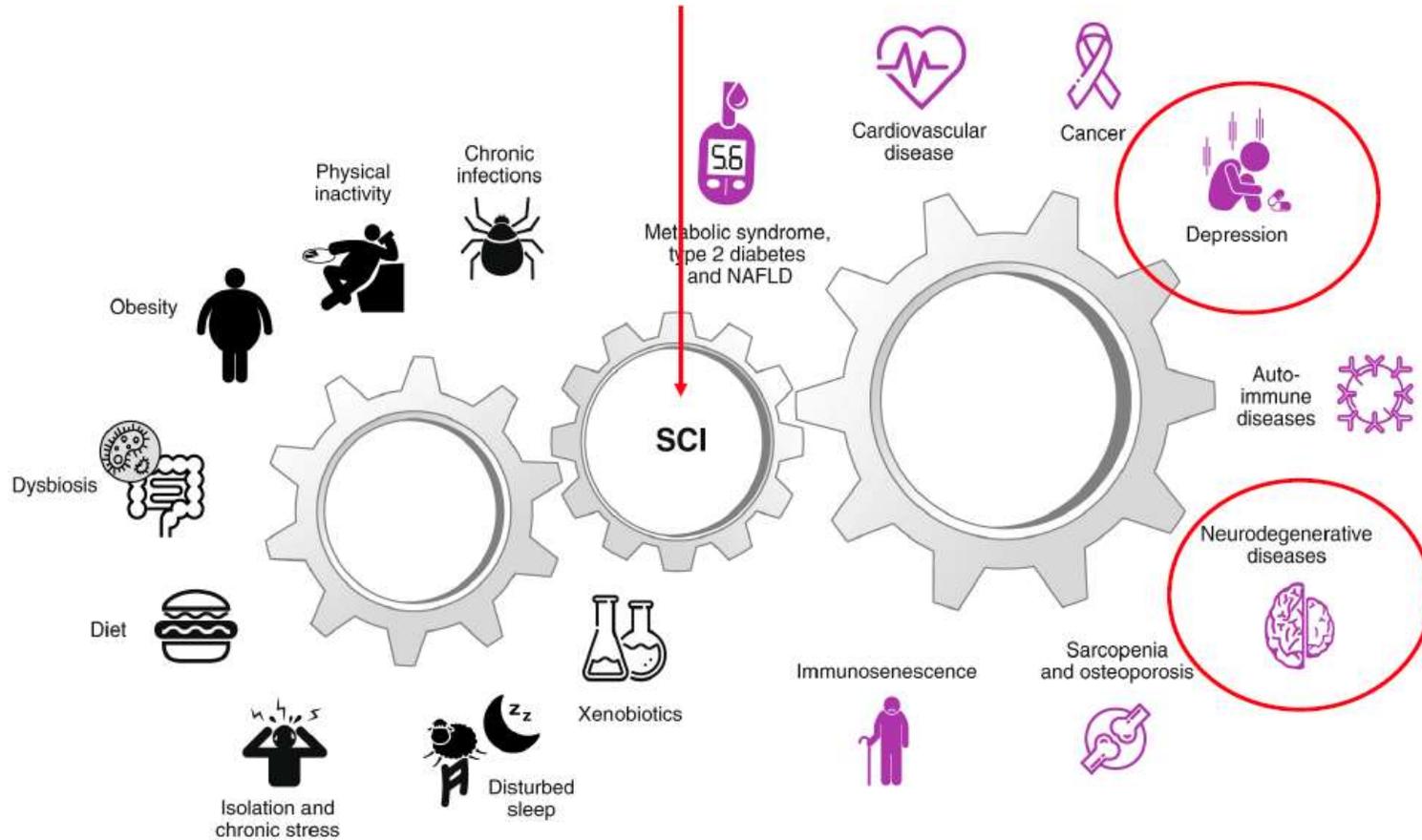
1. AMP Kinase — turns on mitochondria
2. Acyl CoA Dehydrogenase Long-Chain (ACADL) — burns fat
3. Carnitine Palmitoyl Transferase-1 — shuttles fat into mitochondria



"The most important takeaway of this study is that high fructose in the diet is bad," says Dr. Kahn. "It's not bad because it's more calories, but because it has effects on liver metabolism to make it worse at burning fat. As a result, adding fructose to the diet makes the liver store more fat, and this is bad for the liver and bad for whole body metabolism."

C. Ronald Kahn, MD, CEO Joslin Diabetes Center

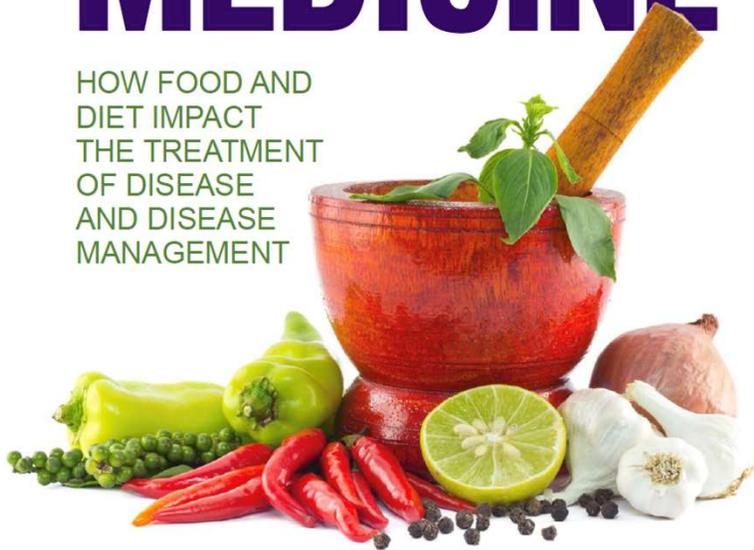
# Systemic Chronic Inflammation



courtesy Dr. Tom O'Bryan

# FOOD AS MEDICINE

HOW FOOD AND DIET IMPACT THE TREATMENT OF DISEASE AND DISEASE MANAGEMENT



CENTER FOR  
**FOOD AS  
MEDICINE**



HUNTER COLLEGE  
NEW YORK CITY  
FOOD POLICY CENTER

Inside the Fauci Wuhan Controversy

12.17.2021  
**Newsweek**

# TOXIC



# FOOD

YOUR MEAL SHOULD COME WITH A WARNING LABEL. **HERE'S WHY.**

## What is the definition of “healthy”?

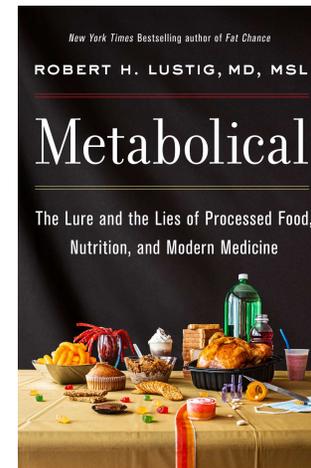
- Michael Pollan said, “Eat Food. Not Too Much. Mostly Plants.”
- *Eat food*: Some need a low-fat diet, others need a high-fat diet.
- *Not too much*: Doesn't take into account mitochondrial dysfunction.
- *Mostly plants*: Coke, Doritos, and Oreos are plant-based.

## What is the definition of “healthy”?

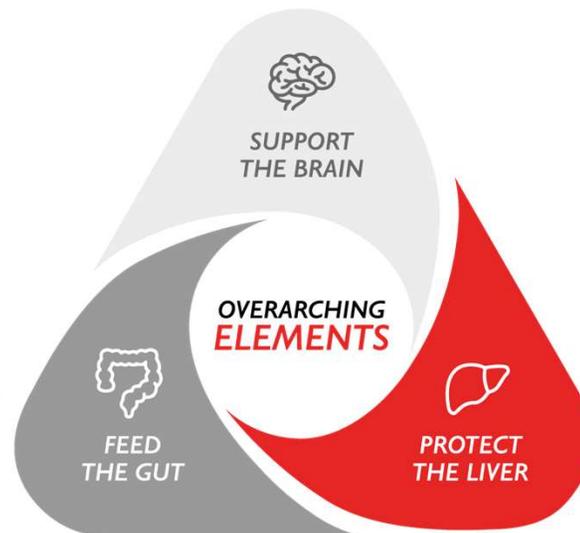
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- It's not *what's in the food*;
  - It's *what's been done to the food*; and really,
  - It's *what they did to the food* that matters.
  - And that's not listed on the food label.

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- It’s not *what’s in the food*;
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  - It’s *what they did to the food* that matters.
  - And that’s not listed on the food label.
- 
- I suggest a different three principles:



Healthy essential fats  
Plant based, short chain, polyunsaturated fatty acids  
Omega 3s: pregnancy, lifespan, childhood, ADHD, depression  
Brain selective nutrients



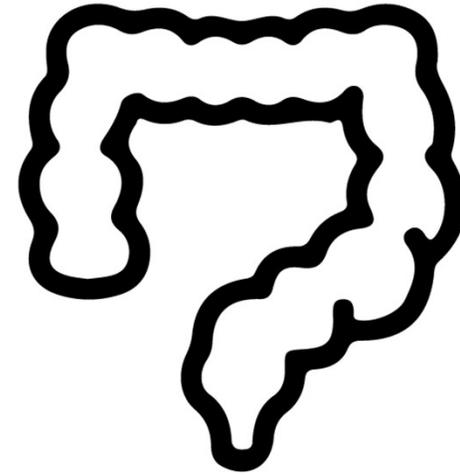
Unprocessed food feeds the gut  
Ultraprocessed food causes “leaky gut”  
Short chain fatty acids  
Fiber contributes to microbiome health

Fructose reduction  
Reduce glycemic load  
Appropriate hydration  
Reduce environmental toxins

## The Metabolic Matrix

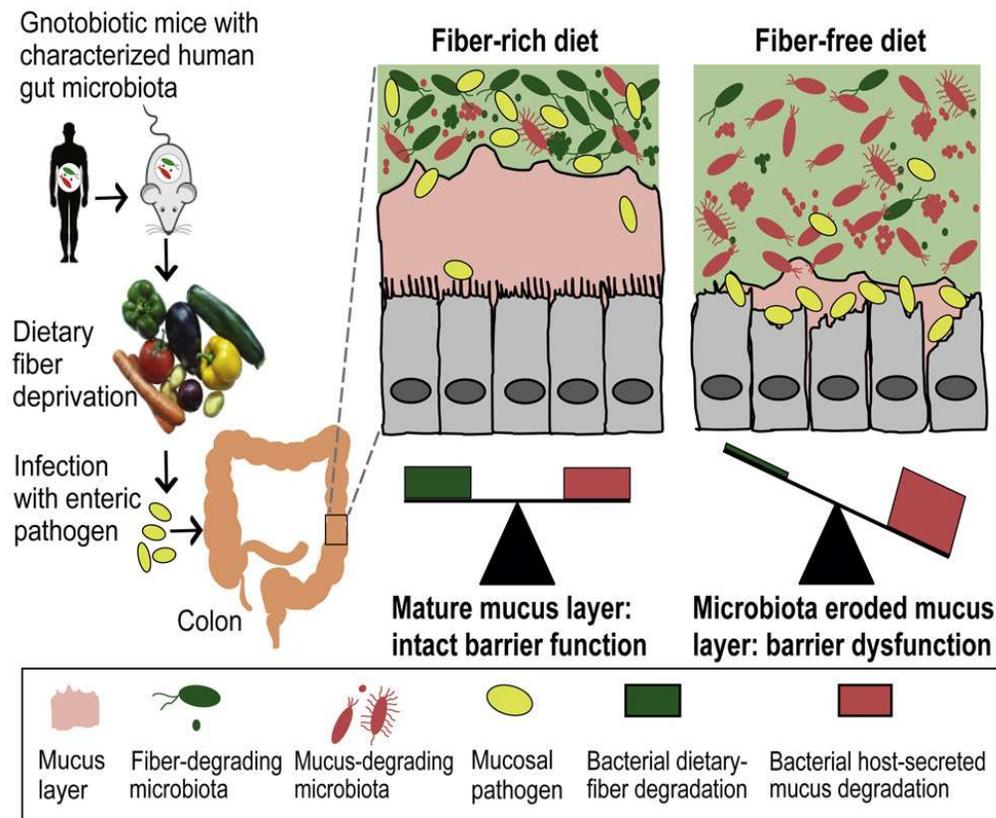
# The Metabolic Matrix: Gut Health

- Digestion, Absorption, Metabolism
- Gut is an organ
- Unprocessed food feeds the gut
- Fiber
- Ultraprocessed food damages the gut
- Microbiome health



***FEED  
THE GUT***

# If you don't feed your gut, your gut will feed on you



# Higher dietary fiber content correlates with reduction in chronic disease

## Soluble + Insoluble Fiber together protects the liver and feeds the gut:

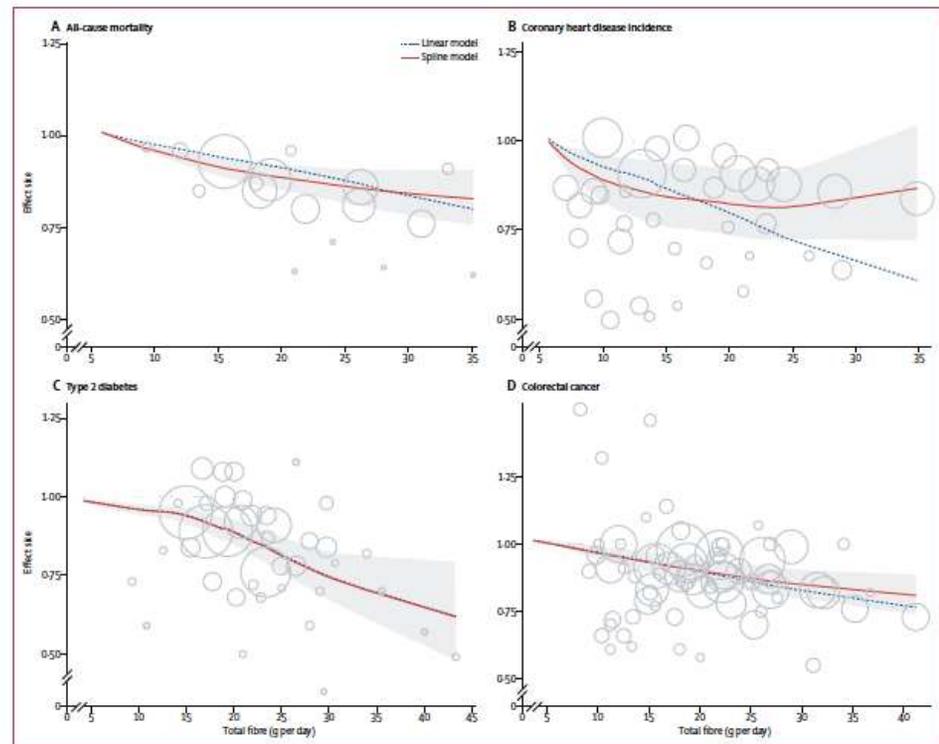
- Acts as a barrier to sugar absorption
- Reduces insulin response
- Feeds the intestinal microbiome
- Induces the satiety signal sooner
- Colonic bacteria make short chain fatty acids
- Removes cancer cells from colon

## Soluble Fiber alone:

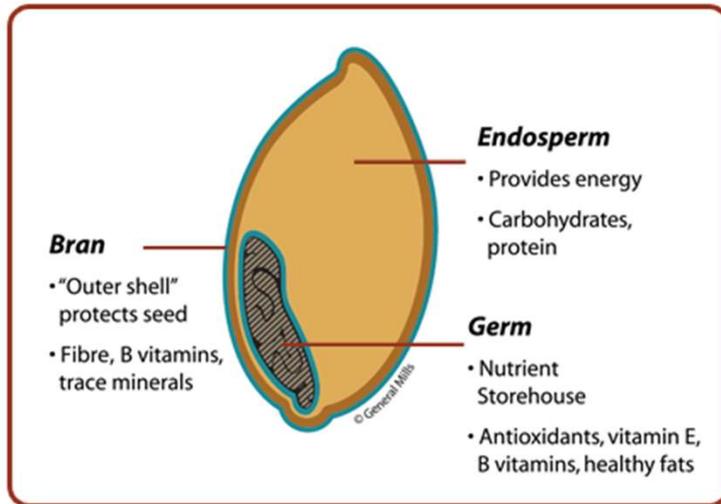
Feeds the intestinal microbiome  
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## Insoluble Fiber alone:

Induces the satiety signal sooner  
Removes cancer cells from colon



# The Metabolic Matrix: Feed the Gut

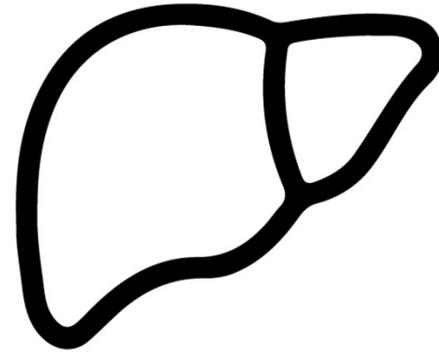


## Fiber is critical

- Supports healthy metabolism & regulates bowel movement through delayed gastric emptying
- Increases satiety
- Helps regulate blood glucose levels
- May help prevent certain cancers
- Lowers LDL (bad cholesterol)
- In Type 2 Diabetics, increasing fiber consumption may reduce fasting glucose and HbA1c

# The Metabolic Matrix: Liver Health

- Fat Fraction Maps
- Fructose reduction, metabolism, etc.
- Reduce total sugar, glycemic load
- Fiber
- Appropriate hydration
- Reduce environmental toxins
- Intestinal barrier



***PROTECT  
THE LIVER***

# The Metabolic Matrix: Protect the Liver

## MRI Fat Fraction Maps



Fat, Metabolically Healthy  
Low Liver Fat = 2.6%

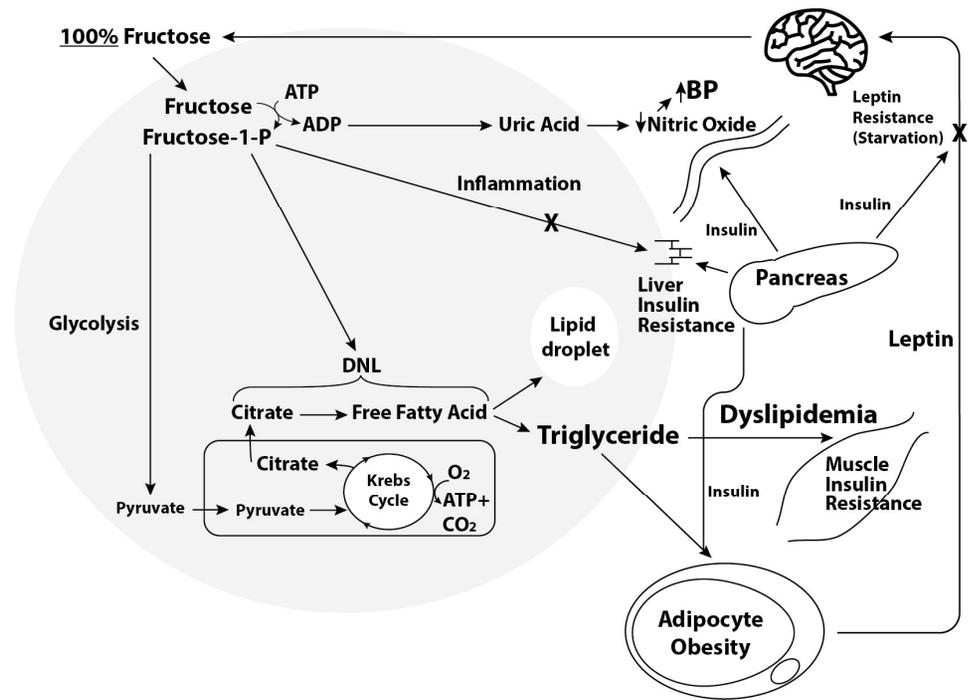
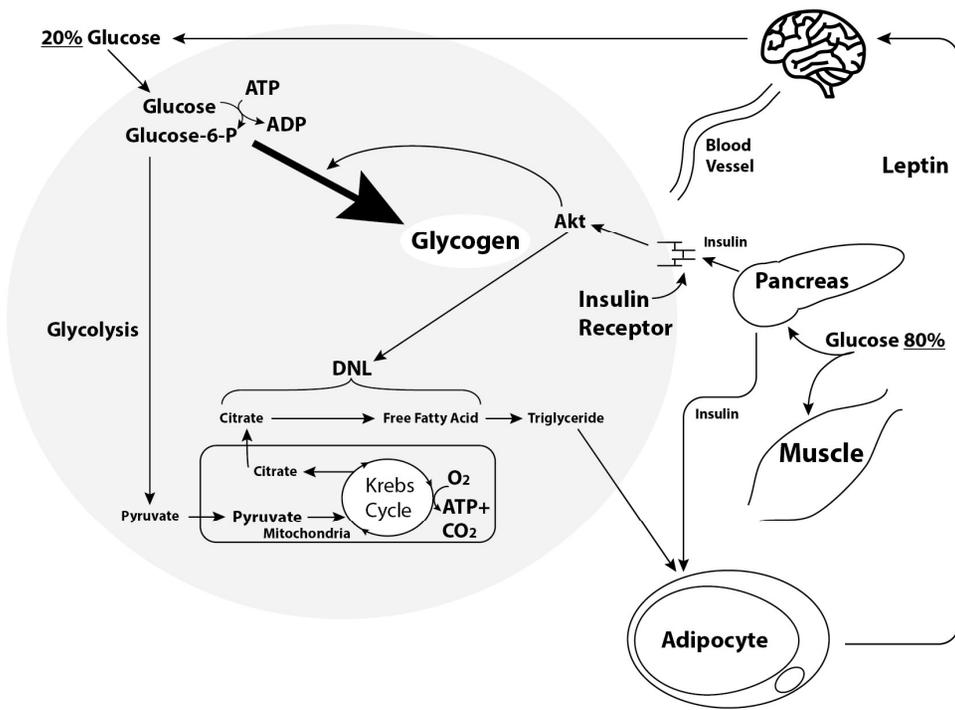


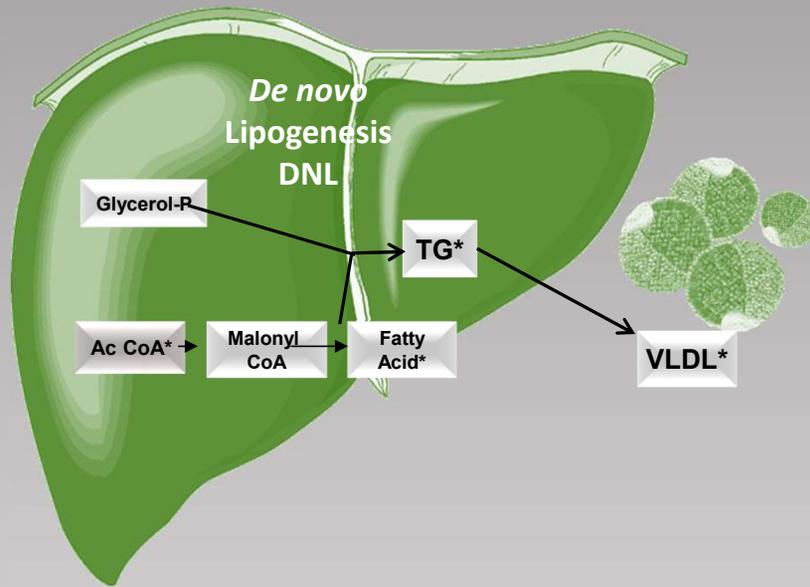
Fat, Metabolically Ill  
High Liver Fat = 24%



Thin, Metabolically Ill  
High Liver Fat = 23%

# Fructose is metabolized in the liver differently than glucose



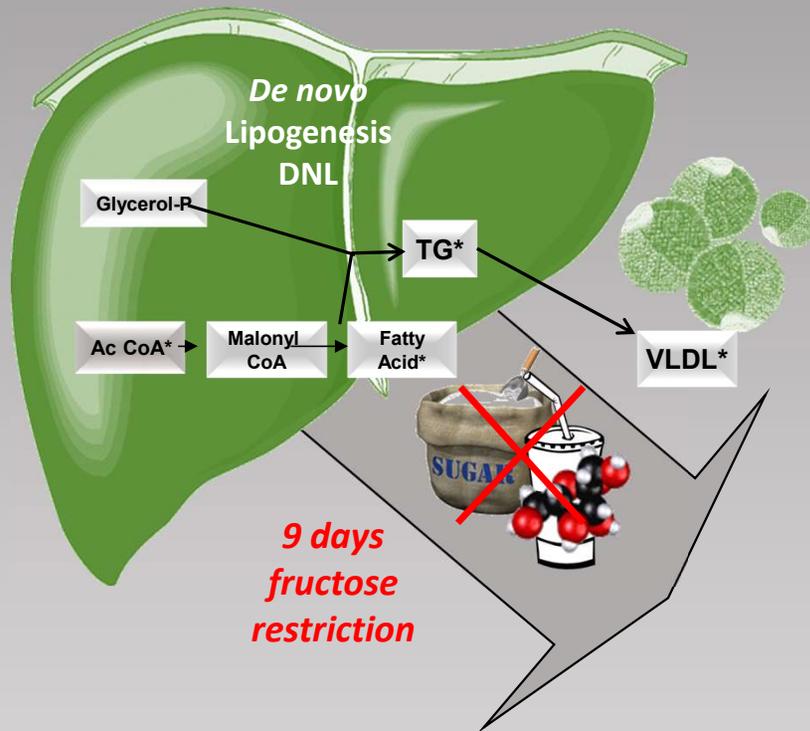


Lustig et al. Obesity 2016

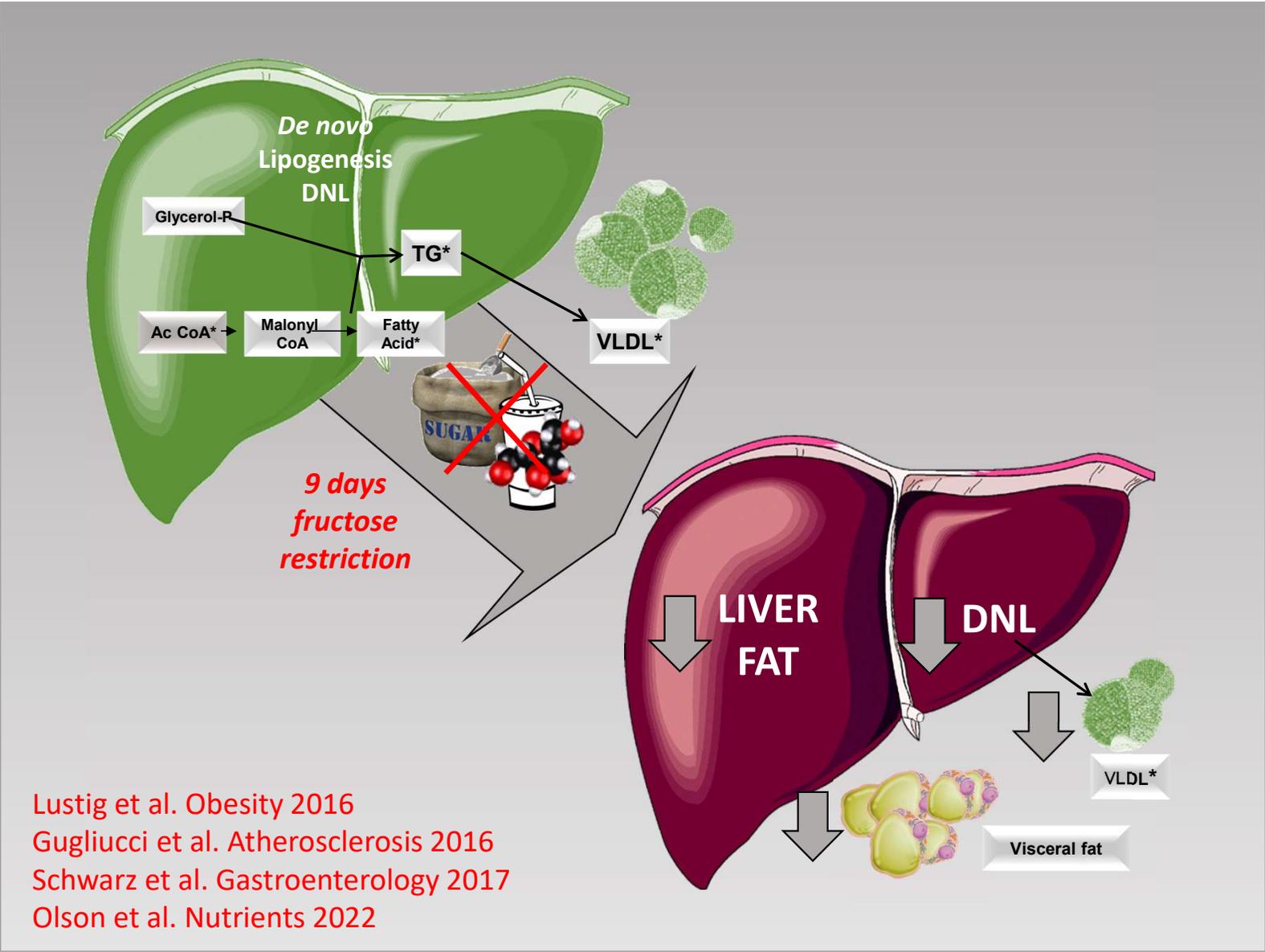
Gugliucci et al. Atherosclerosis 2016

Schwarz et al. Gastroenterology 2017

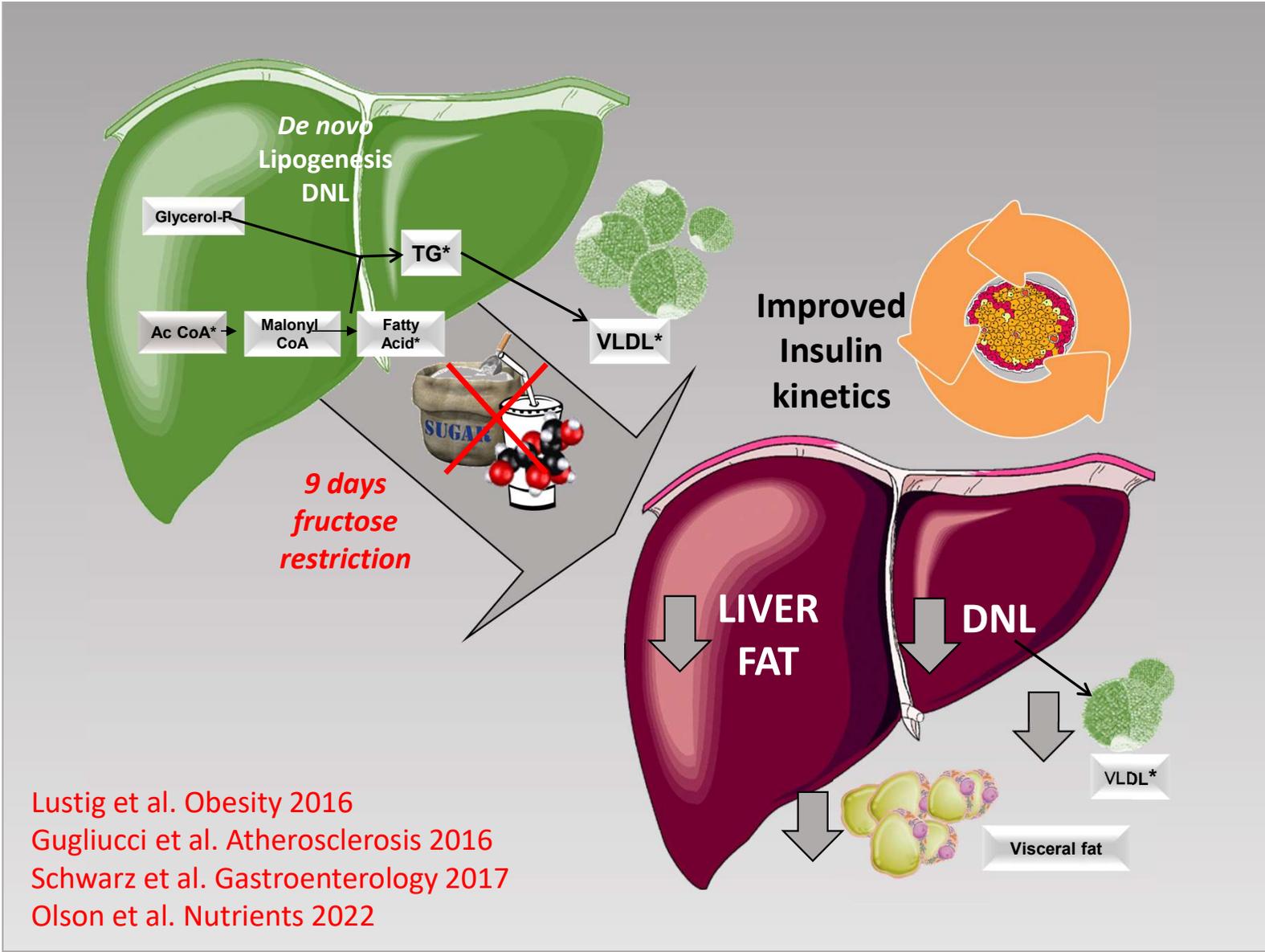
Olson et al. Nutrients 2022



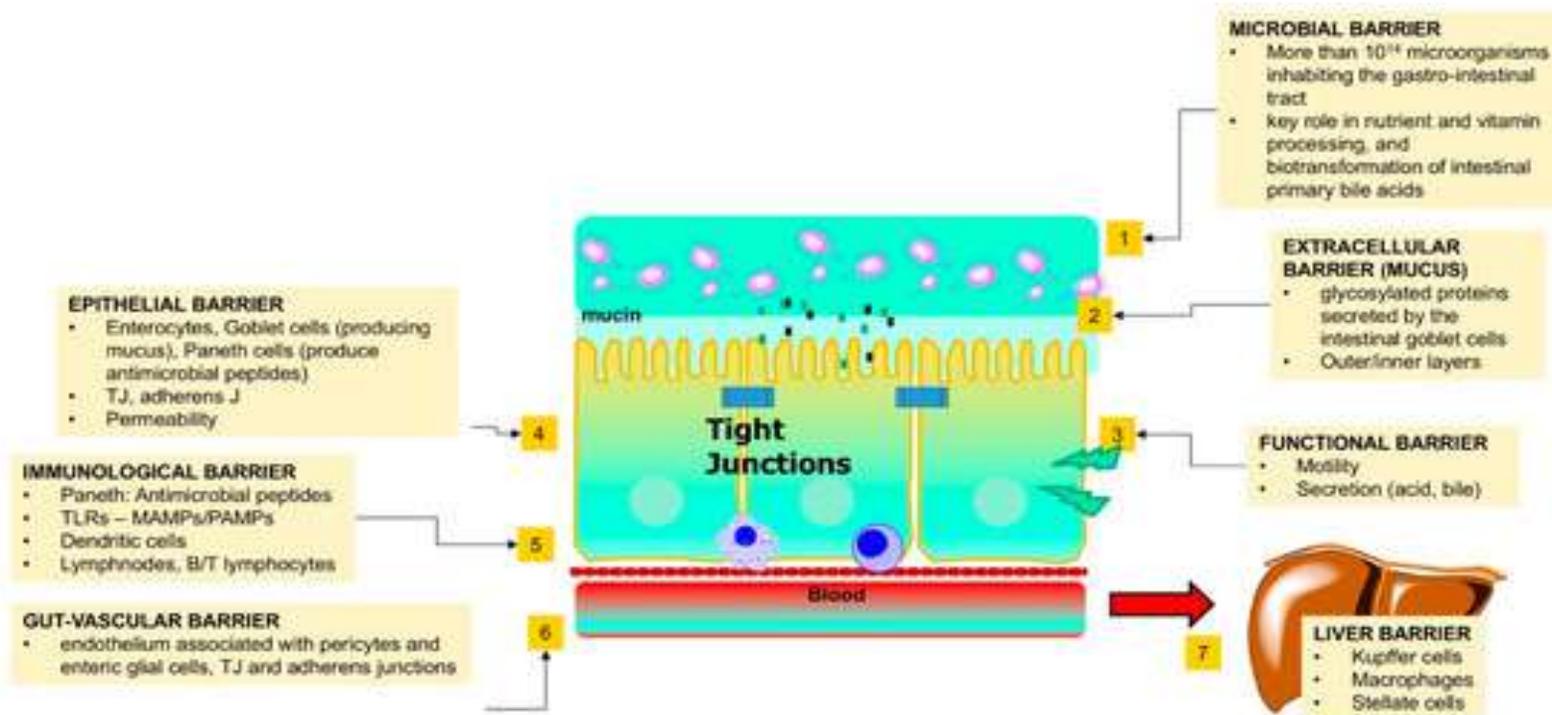
Lustig et al. Obesity 2016  
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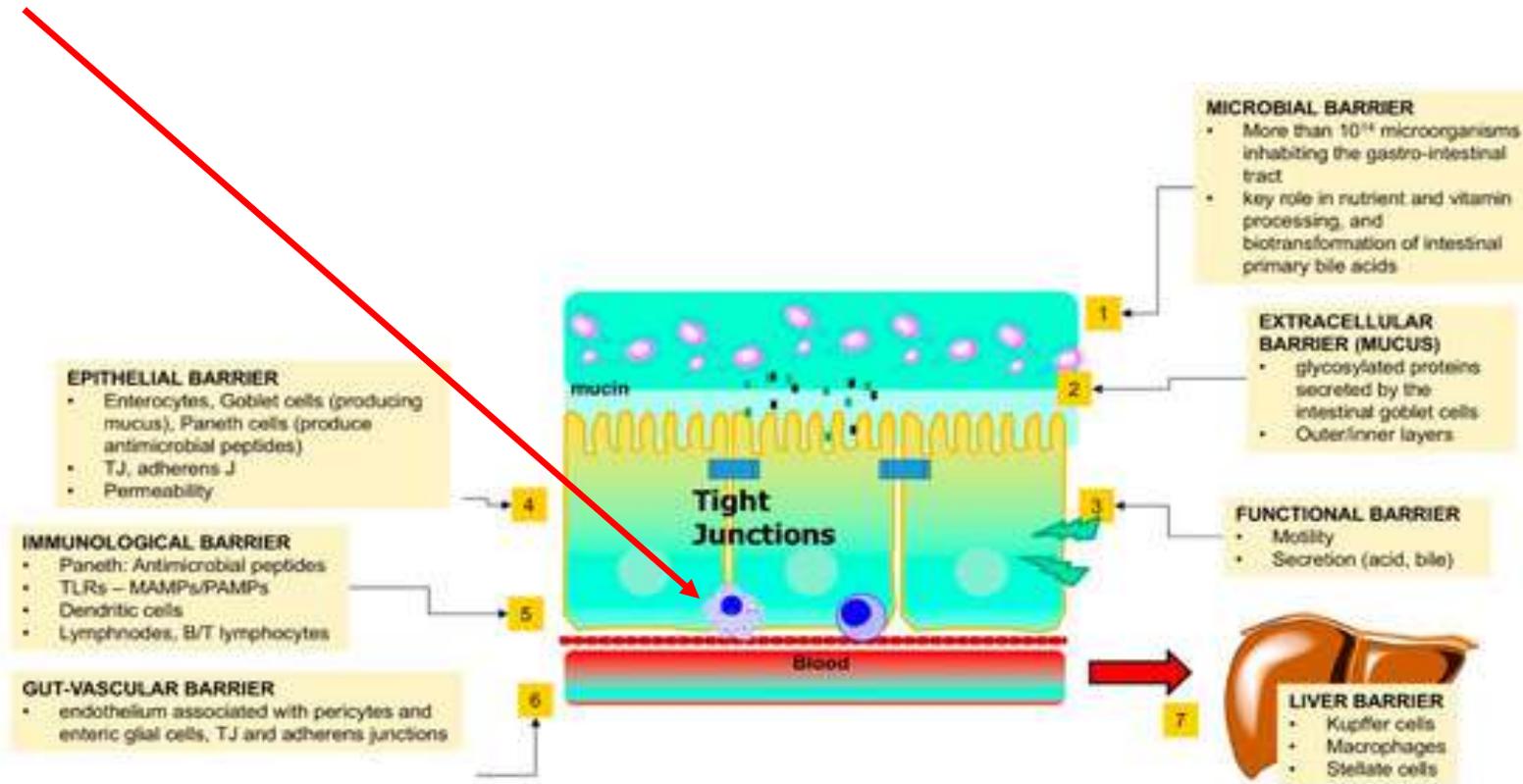


# Tight junctions keep bad stuff out

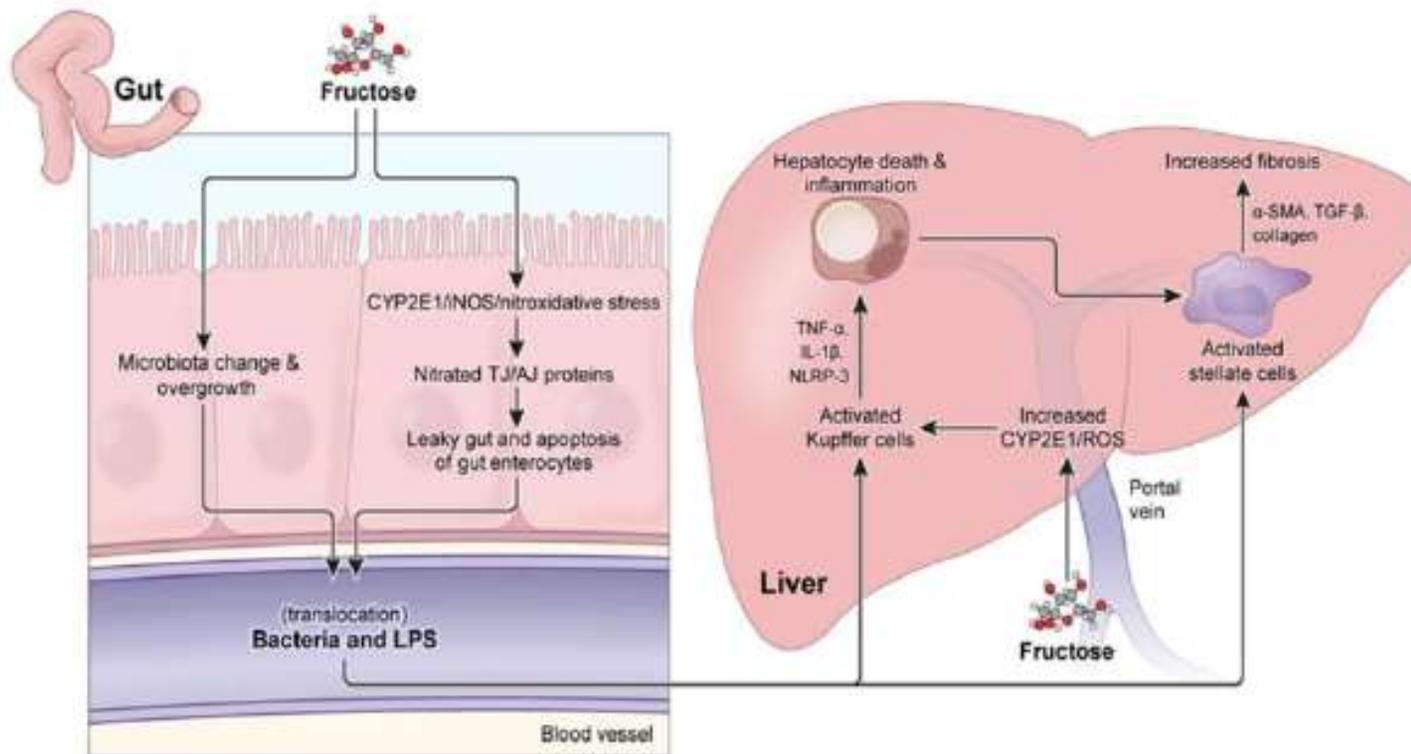


# Tight junctions keep bad stuff out

Gluten is a direct immunotoxin of zonulins, both in intestine AND brain– cause of Celiac Disease



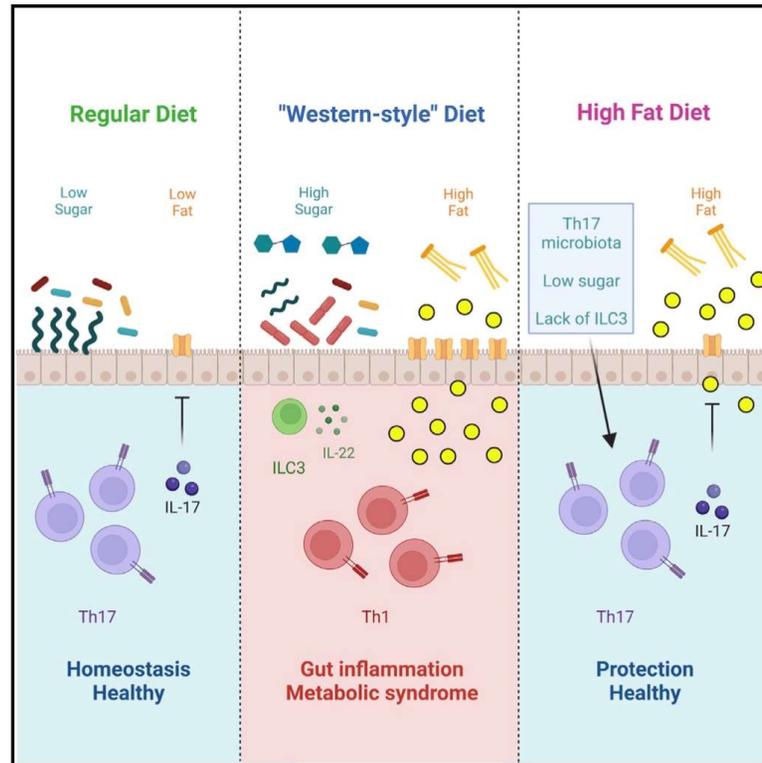
# Fructose also disrupts tight junctions, and lets bad stuff in



Cho et al. Hepatology 2019 Apr 8. doi: 10.1002/hep.30652.

# Sugar alters Th17 barrier in the intestine

Graphical abstract



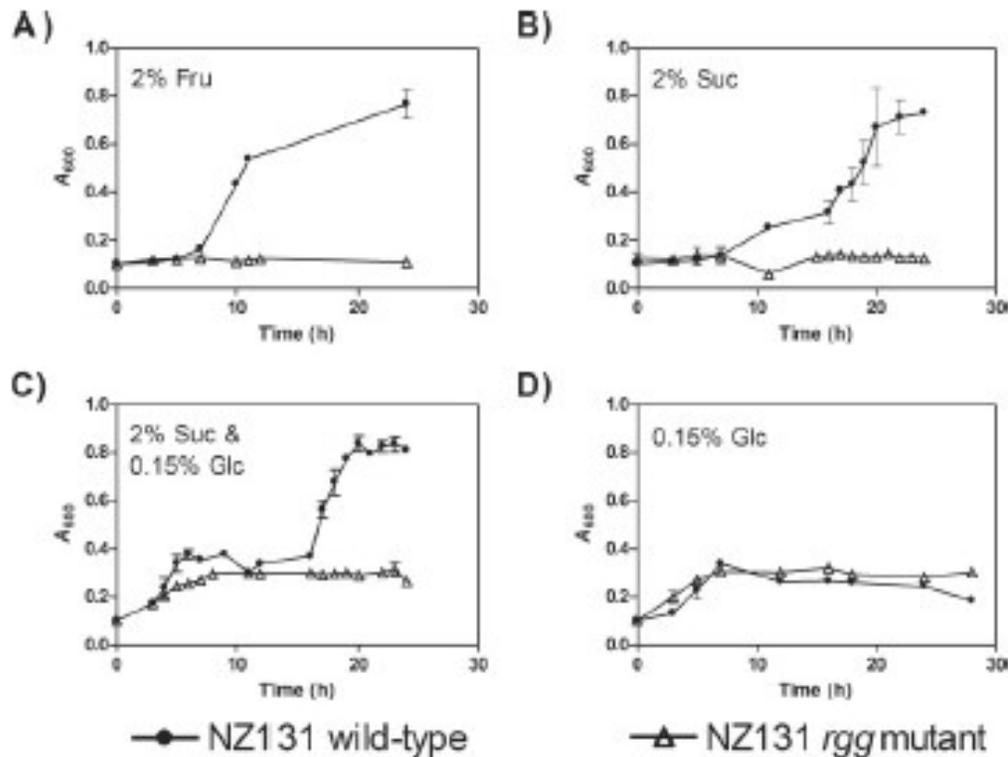
Article

# Dietary Intake of Free Sugars is Associated with Disease Activity and Dyslipidemia in Systemic Lupus Erythematosus Patients

María Correa-Rodríguez <sup>1,2</sup>, Gabriela Pocovi-Gerardino <sup>1,2,\*</sup>, José-Luis Callejas-Rubio <sup>3</sup>, Raquel Ríos Fernández <sup>3</sup>, María Martín-Amada <sup>4</sup>, María-Gracia Cruz-Caparros <sup>5</sup>, Irene Medina-Martínez <sup>1</sup>, Norberto Ortego-Centeno <sup>2,3,†</sup> and Blanca Rueda-Medina <sup>1,2,†</sup>

1. Higher consumption of free sugars in active vs. inactive SLE  
(8.60% ± 5.51 vs, 6.36% ± 4.82;  $p = 0.020$ )
2. Association between consumption of free sugars and number of complications of SLE

# Group A Streptococcus grow better with fructose than glucose



GAS responsible for psych disease:

- 1) Sydenham's chorea
- 2) PANDAS
  - OCD
  - tic disorders
  - adult personality dis.
  - mood disorder

Dmitriev et al. J Bacteriol 188:7230, 2006

Orlovska et al. JAMA Pediatr. 74:740, 2017

# Fructose and Cancer/Dementia

 CellPress

Cell Metabolism

Perspective

## “Sweet death”: Fructose as a metabolic toxin that targets the gut-liver axis

Mark A. Febbraio<sup>1,\*</sup> and Michael Karin<sup>2,\*</sup>

<sup>1</sup>Monash Institute of Pharmaceutical Sciences, Monash University, Parkville, VIC, Australia

<sup>2</sup>Department of Pharmacology, School of Medicine, University of California, San Diego, San Diego, CA, USA

\*Correspondence: [mark.february@monash.edu](mailto:mark.february@monash.edu) (M.A.F.), [mkarin@health.ucsd.edu](mailto:mkarin@health.ucsd.edu) (M.K.)

<https://doi.org/10.1016/j.cmet.2021.09.004>

Febbraio et al. Cell Metab 33:2316, 2021



Journal of Genetics and  
Genomics

ELSEVIER

Volume 48, Issue 7, 20 July 2021, Pages 531-539



Review

## Fructose and fructose kinase in cancer and other pathologies

[Hongfei Jiang](#)<sup>a</sup>, [Qian Lin](#)<sup>a</sup>, [Leina Ma](#)<sup>a</sup>, [Shudi Luo](#)<sup>c</sup>, [Xiaoming Jiang](#)<sup>c</sup>,  
[Jing Fang](#)<sup>a</sup>  , [Zhimin Lu](#)<sup>b c</sup>  

Jiang et al. J Genet Genom 48:531, 2021

 frontiers  
in Aging Neuroscience



## Cerebral Fructose Metabolism as a Potential Mechanism Driving Alzheimer's Disease

[Richard J. Johnson](#)<sup>1\*</sup>, [Fernando Gomez-Pinilla](#)<sup>2</sup>, [Maria Nagel](#)<sup>3</sup>, [Takahiko Nakagawa](#)<sup>4</sup>,  
[Bernardo Rodriguez-Iturbe](#)<sup>5</sup>, [Laura G. Sanchez-Lozada](#)<sup>5</sup>, [Dean R. Tolan](#)<sup>6</sup>  
and [Miguel A. Lanaspá](#)<sup>1</sup>

Johnson et al. Front Aging Neurosci 12:560865, 2020

**Sugar is the marker for ultra-processed food**  
**56% of the food sold in America is ultra-processed food**  
**Accounts for 62% of the sugar in the American diet**

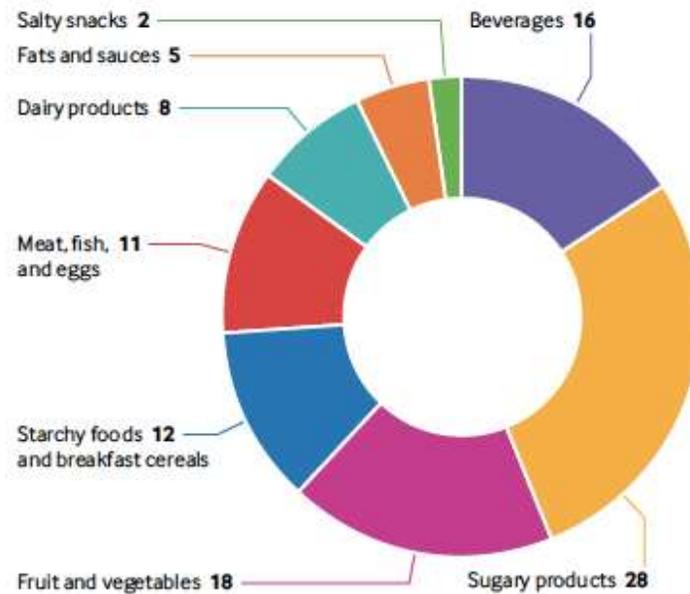


Fig 2 | Relative contribution (%) of each food group to consumption of ultra-processed food in diet

# The Metabolic Matrix: Brain Health

- What is your brain made of?
- Healthy & essential fats
- Plant based, short chain, polyunsaturated fatty acids
- Balance of omega 3 & 6 in the brain
- Omega 6
- Omega 3s: pregnancy, lifespan, childhood
- ADHD and depression
- Brain selective nutrients



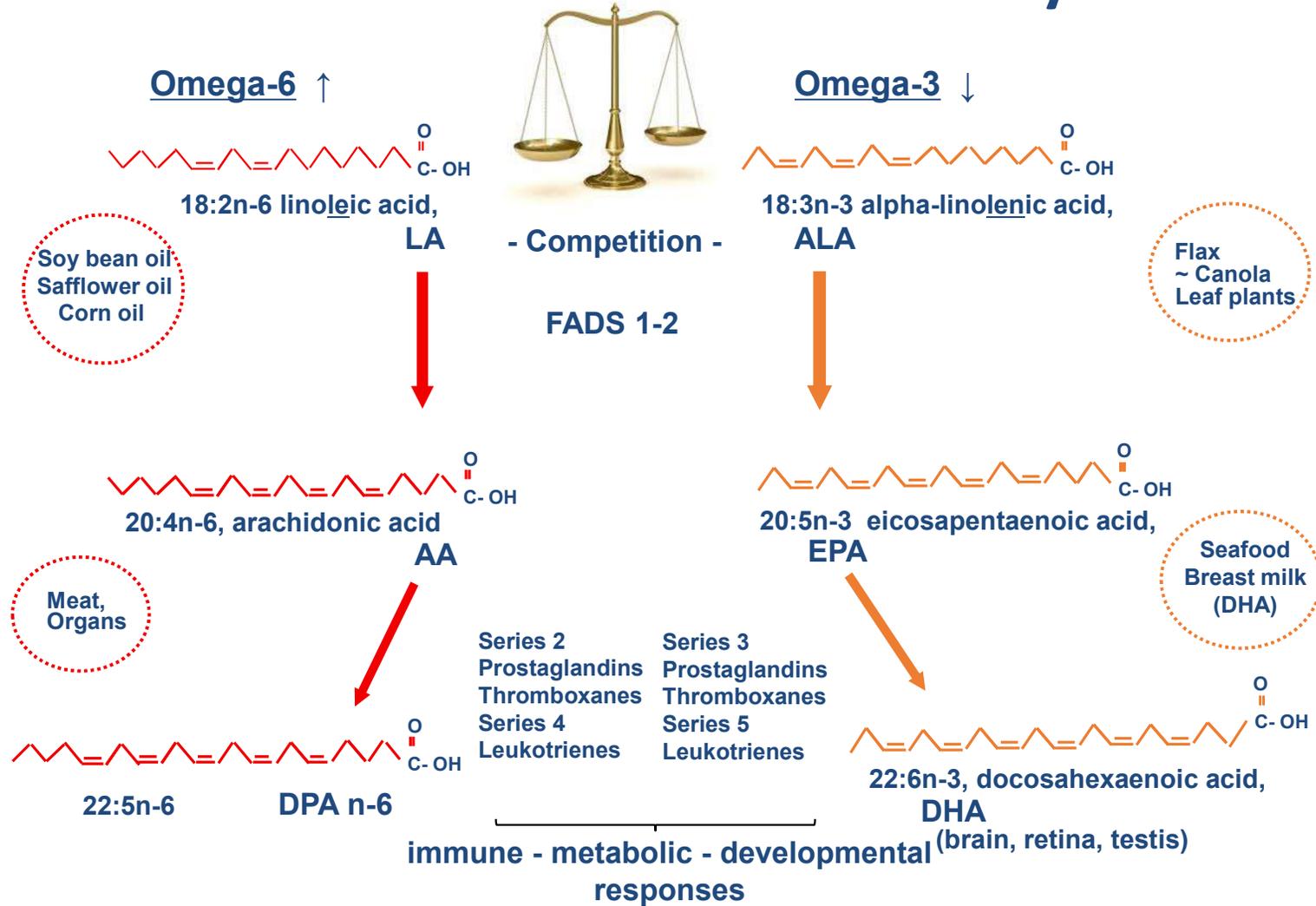
***SUPPORT  
THE BRAIN***

A hand is shown holding a glowing, wireframe model of a human brain. The brain is rendered in a translucent, yellowish-white color with a complex, interconnected network of lines representing neural pathways. The hand is positioned in the lower half of the frame, with the fingers gently cradling the base of the brain. The background is a dark, textured grey. The overall lighting is soft and focused on the brain, creating a sense of depth and highlighting its intricate structure.

What is your brain made of?



# Essential Fats: Metabolism and Dietary Sources



# Poor psychiatric health is persistently linked to low omega-3

Table 2. Fatty acid composition (%) of red blood cell data in adults with ADHD (n = 30)

	ADHD	
	M	SD
<b>Omega 6</b>		
c18: 2n-6 (LA)	13.95	1.62
c18: 3n6	0.08	0.03
c20: 2n6	0.30	0.05
c20:3n6	1.55	0.36
c20: 4n6 (AA)	13.71	1.35
c22: 4n6	3.67	0.53
c22: 5n6	0.53	0.10
Total n6	33.87	2.25
<b>Omega 3</b>		
c18: 3n3 (ALA)	0.19	0.04
c20: 5n3 (EPA)	0.53	0.18
c22: 5n3	2.05	0.24
c22: 6n3 (DHA)	3.80	0.95
Total n3	6.57	1.22



People with schizophrenia and depression have a low omega-3 index

Natalie Parletta<sup>a</sup>, Dorota Zarnowiecki<sup>b</sup>, Jihyun Cho<sup>b</sup>, Amy Wilson<sup>b</sup>, Nicholas Procter<sup>c</sup>, Andrea Gordon<sup>c</sup>, Svetlana Bogomolova<sup>b</sup>, Kerin O'Dea<sup>a</sup>, John Strachan<sup>d</sup>, Matt Ballestrin<sup>d</sup>, Andrew Champion<sup>d</sup>, Barbara J Meyer<sup>e</sup>

## Comparison of Means

n-3:  $M = 5.63$ ,  $SD = 1.25$

n-6:  $M = 25.27$ ,  $SD = 3.74$

The omega-3 index in Parletta et al (2016) study was **3.95%** in comparison to the omega-3 index in NORAA participants which was: **4.33%**



# ADHD and Depression

- Several meta-analyses have confirmed a small-modest effect size for reducing clinical symptoms of ADHD in children (see Hawkey & Niggs 2014, Clin Psychol Rev)
- Hallahan, Davis et al., Br J Psychiatry, 2016 confirmed an effect size of 0.61 (Cohens *d*) for reducing clinical depression – in both cases EPA-rich formulations had the greatest efficacy



# The Metabolic Matrix Explains What Nutrition Needs To Do

- **The science is clear:**
  - more soluble and insoluble fiber (to feed the gut)
  - less fructose (to protect the liver)
  - more  $\alpha$ -linolenic acid, EPA, DHA (to support the brain)
- **A Low Insulin Diet = A Real Food Diet**
- **The challenge is going from knowledge to transformation**
  - **We must "Debunk the Calorie", and promote metabolic health**

TIME



SHOPPING CART

GETTY IMAGES—KUTAY TANIR

# Why Ultra-Processed Foods Are So Bad for You

Recent research finds that highly processed food may pose health risks.

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TARA LAW

JAN 09, 2023 9:06 AM PST

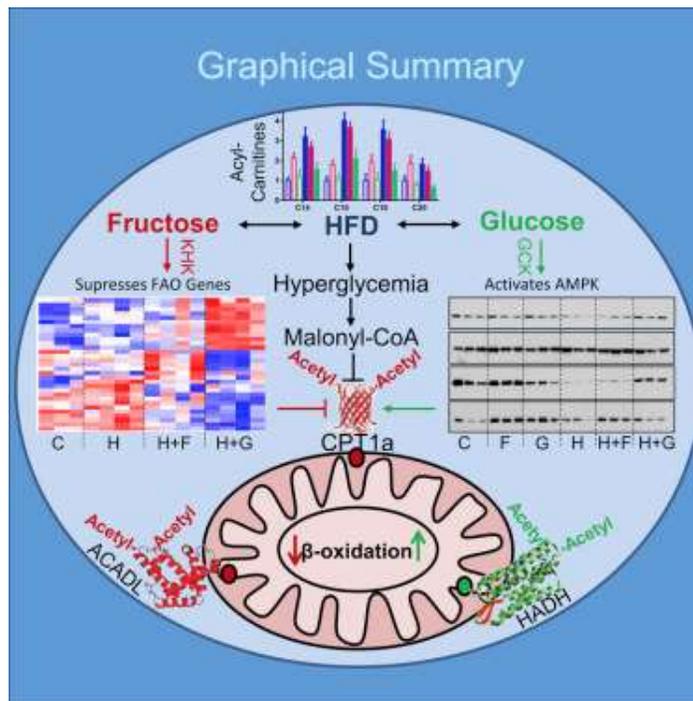
**Is ultraprocessed food “food”?**

## Is ultraprocessed food “food”?

Food: Substrate that contributes either to the burning or growth of an organism

# Burning:

## Ultraprocessed food inhibits mitochondria

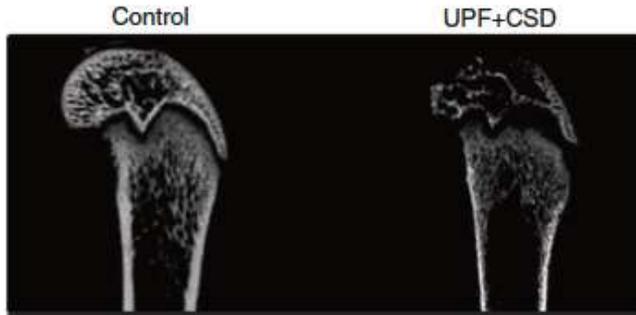


"The most important takeaway of this study is that high fructose in the diet is bad," says Dr. Kahn. "It's not bad because it's more calories, but because it has effects on liver metabolism to make it worse at burning fat. As a result, adding fructose to the diet makes the liver store more fat, and this is bad for the liver and bad for whole body metabolism."

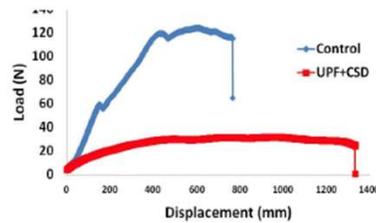
Dr. C. Ronald Kahn, CEO  
Joslin Diabetes Center

Softic et al. Cell Metab 30:735, 2019

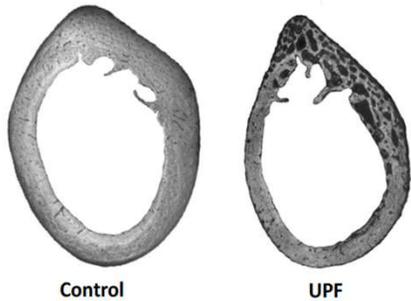
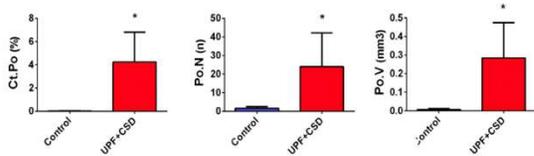
# Growth: Ultraprocessed food inhibits bone growth



## D. Mechanical properties



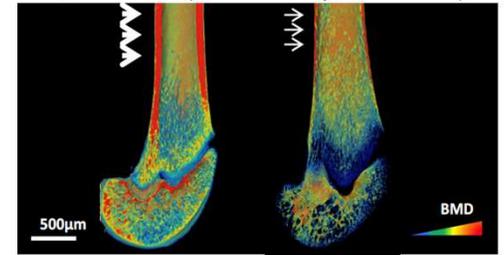
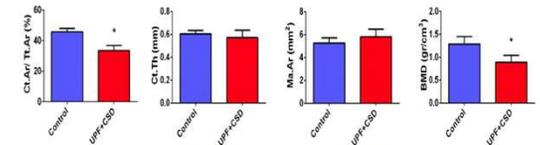
## C. Cortical porosity



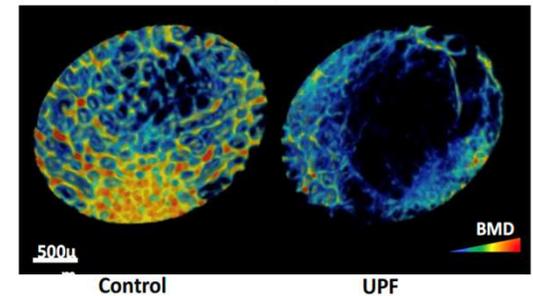
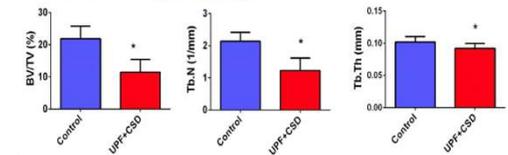
Tested parameter	Control	UPF+CSD
Stiffness (N/mm)	393.5 ± 58.9	103.5 ± 40.6*
Yield (N)	57.7 ± 6.4	27.0 ± 4.0*
Fracture load (N)	94.7 ± 10.5	24.7 ± 4.5*
Max load (N)	110.9 ± 10.1	37.8 ± 6.4*

UPF: Ultraprocessed food  
CSD: Caloric soft drink

## B. Cortical analysis



## A. Trabecular analysis



Zaretsky et al. Bone Res 9:14, 2021

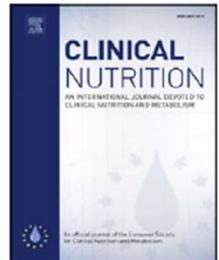


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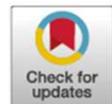
## Clinical Nutrition

journal homepage: <http://www.elsevier.com/locate/clnu>



Original article

### Consumption of ultra-processed foods associated with weight gain and obesity in adults: A multi-national cohort study



Reynalda Cordova <sup>a, b</sup>, Nathalie Kliemann <sup>a</sup>, Inge Huybrechts <sup>a</sup>, Fernanda Rauber <sup>c, d</sup>, Eszter P. Vamos <sup>e</sup>, Renata Bertazzi Levy <sup>c, d</sup>, Karl-Heinz Wagner <sup>b</sup>, Vivian Viallon <sup>a</sup>, Corinne Casagrande <sup>a</sup>, Geneviève Nicolas <sup>a</sup>, Christina C. Dahm <sup>f</sup>, Jie Zhang <sup>f</sup>, Jytte Halkjær <sup>g</sup>, Anne Tjønneland <sup>g, h</sup>, Marie-Christine Boutron-Ruault <sup>i, j</sup>, Francesca Romana Mancini <sup>i, j</sup>, Nasser Laouali <sup>i, j</sup>, Verena Katzke <sup>k</sup>, Bernard Srour <sup>k</sup>, Franziska Jannasch <sup>l, m, n</sup>, Matthias B. Schulze <sup>l, o</sup>, Giovanna Masala <sup>p</sup>, Sara Gioni <sup>q</sup>, Salvatore Panico <sup>r</sup>, Yvonne T. van der Schouw <sup>s</sup>, Jeroen W.G. Derksen <sup>s</sup>, Charlotta Rylander <sup>t</sup>, Guri Skeie <sup>t</sup>, Paula Jakszyn <sup>u, v</sup>, Miguel Rodriguez-Barranco <sup>w, x, y</sup>, José María Huerta <sup>z, aa</sup>, Aurelio Barricarte <sup>y, ab, ac</sup>, Lousie Brunkwall <sup>ad</sup>, Stina Ramne <sup>ad</sup>, Stina Bodén <sup>ae</sup>, Aurora Perez-Cornago <sup>af</sup>, Alicia K. Heath <sup>e</sup>, Paolo Vineis <sup>e</sup>, Elisabete Weiderpass <sup>a</sup>, Carlos Augusto Monteiro <sup>c, d</sup>, Marc J. Gunter <sup>a</sup>, Christopher Millett <sup>e</sup>, Heinz Freisling <sup>a, \*</sup>

Article

# **Ultra-Processed Food Consumption Associated with Incident Hypertension among Chinese Adults—Results from China Health and Nutrition Survey 1997–2015**

Ming Li <sup>1,\*</sup>  and Zumin Shi <sup>2</sup> 



Research

JAMA Internal Medicine | [Original Investigation](#)

# Ultraprocessed Food Consumption and Risk of Type 2 Diabetes Among Participants of the NutriNet-Santé Prospective Cohort

Bernard Srour, PharmD, MPH, PhD; Léopold K. Fezeu, MD, PhD; Emmanuelle Kesse-Guyot, MSc, PhD;  
Benjamin Allès, PhD; Charlotte Debras, MSc; Nathalie Druesne-Pecollo, PhD; Eloi Chazelas, MSc;  
Mélanie Deschasaux, MSc, PhD; Serge Hercberg, MD, PhD; Pilar Galan, MD, PhD;  
Carlos A. Monteiro, MD, PhD; Chantal Julia, MD, MPH, PhD; Mathilde Touvier, PhD, MSc, MPH

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<https://doi.org/10.1093/eurpub/ckac104> Advance Access published on 25 August 2022

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# **Associations of ultra-processed food consumption with cardiovascular disease and all-cause mortality: UK Biobank**

Xuanli Chen , Jiadong Chu, Wei Hu, Na Sun, Qida He, Siyuan Liu, Zhaolong Feng, Tongxing Li, Qiang Han, Yueping Shen

## **Association between ultra-processed foods consumption and risk of non-alcoholic fatty liver disease: a population-based analysis of NHANES 2011–2018**

Zhening Liu, Hangkai Huang, Yan Zeng, Yishu Chen and Chengfu Xu\*

*Department of Gastroenterology, The First Affiliated Hospital, Zhejiang University School of Medicine, 79 Qingchun Road, Hangzhou 310003, People's Republic of China*



# Ultra-processed food consumption and metabolic syndrome: a cross-sectional study in Quilombola communities of Alagoas, Brazil

Lídia Bezerra Barbosa<sup>1,2</sup> , Nancy Borges Rodrigues Vasconcelos<sup>1</sup> , Ewerton Amorim dos Santos<sup>3</sup> , Tamara Rodrigues dos Santos<sup>1</sup> , Thays Ataide-Silva<sup>2</sup>  and Haroldo da Silva Ferreira<sup>2\*</sup> 



Manuscript Doi: 10.1093/ecco-jcc/jjac167

# **Intake of ultra-processed foods is associated with an increased risk of Crohn's disease: a cross-sectional and prospective analysis of 187,154 participants in the UK Biobank**

Jie Chen,<sup>a, b\*</sup> Judith Wellens,<sup>c, d\*</sup> Rahul Kalla,<sup>e</sup> Tian Fu,<sup>b</sup> Minzi Deng,<sup>b</sup> Han Zhang,<sup>a</sup> Shuai Yuan,<sup>f</sup> Xiaoyan Wang,<sup>b, #</sup> Evropi Theodoratou,<sup>g, h, †</sup> Xue Li,<sup>a, #</sup> Jack Satsangi,<sup>c, †</sup>



OPEN ACCESS

## Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort

Thibault Fiolet,<sup>1</sup> Bernard Srour,<sup>1</sup> Laury Sellem,<sup>1</sup> Emmanuelle Kesse-Guyot,<sup>1</sup> Benjamin Allès,<sup>1</sup> Caroline Méjean,<sup>2</sup> Mélanie Deschasaux,<sup>1</sup> Philippine Fassier,<sup>1</sup> Paule Latino-Martel,<sup>1</sup> Marie Beslay,<sup>1</sup> Serge Hercberg,<sup>1,4</sup> Céline Lavalette,<sup>1</sup> Carlos A Monteiro,<sup>3</sup> Chantal Julia,<sup>1,4</sup> Mathilde Touvier<sup>1</sup>

September 06, 2022; 99 (10) [RESEARCH ARTICLES](#)

## **Association of Ultraprocessed Food Consumption With Risk of Dementia**

### **A Prospective Cohort Study**

Huiping Li, Shu Li, Hongxi Yang, Yuan Zhang, Shunming Zhang, Yue Ma, Yabing Hou, Xinyu Zhang, Kaijun Niu, Yan Borné, Yaogang Wang

First published July 27, 2022, DOI: <https://doi.org/10.1212/WNL.0000000000200871>

American Journal of  
**Preventive Medicine**

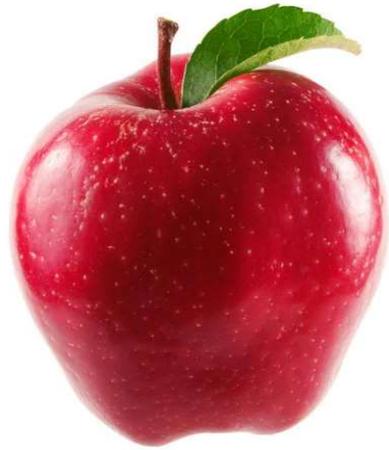
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**GLOBAL HEALTH PROMOTION AND PREVENTION**

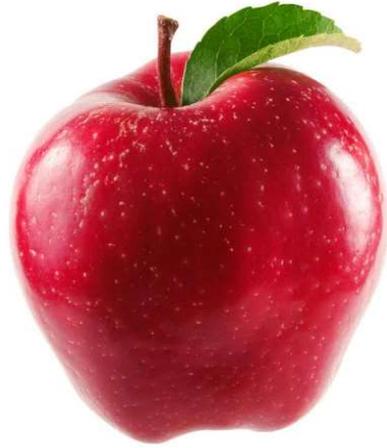
Premature Deaths Attributable to the Consumption  
of Ultraprocessed Foods in Brazil

Eduardo A.F. Nilson, ScD,<sup>1,2</sup> Gerson Ferrari, PhD,<sup>3</sup> Maria Laura C. Louzada, PhD,<sup>4</sup>  
Renata B. Levy, PhD,<sup>5</sup> Carlos A. Monteiro, PhD,<sup>1</sup> Leandro F.M. Rezende, ScD<sup>6</sup>

NOVA I

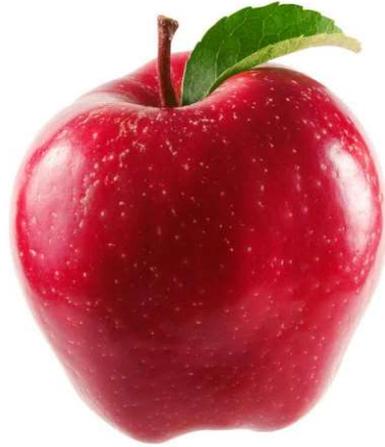


NOVA I



NOVA II

NOVA I



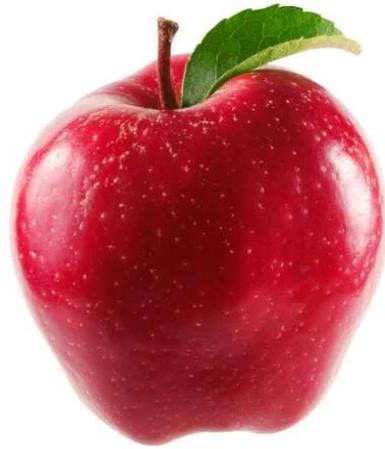
NOVA II



NOVA III



NOVA I



NOVA II



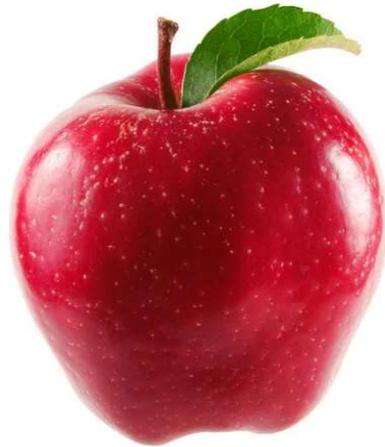
NOVA III



NOVA IV



NOVA I



NOVA II



NOVA III



NOVA IV



Only NOVA IV correlates with chronic disease  
57% of US consumption  
73% of US food supply

Nutrition

# 'Ultra-processed' products now half of all UK family food purchases

Exclusive: health experts warn increasing popularity of industrially-made food will lead to negative effects such as obesity and poor health



▲ Some of the UK's best-selling ultra-processed foods. Photograph: Jill Mead for the Guardian

Sarah Boseley Health editor

# Americans Are Eating More Ultra-Processed Foods: How to Cut Down on Them



Fast food such as hamburgers are among the ultra-processed foods that people are eating more often. Evrim Ertik/Getty Images

57% of US consumption  
73% of the US food supply

# Processed food and its role in nutritious and sustainable diets



## VIEWPOINT

## Processed Food—An Experiment That Failed

**Robert H. Lustig, MD, MSL**

Department of Pediatrics, University of California, San Francisco; and Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco.

### Corresponding

**Author:** Robert H. Lustig, MD, MSL, Division of Pediatric Endocrinology, University of California, San Francisco, 550 16th St, PO Box 0434, San Francisco, CA 94143 (rlustig@ucsf.edu).

**Those of us** who have participated in science know that 9 of every 10 experiments are failures. Now imagine that the last 50 years has been a grand clinical research experiment, with the American population as unwitting participants, conducted by 10 principal investigators—Coca-Cola, Pepsico, Kraft, Unilever, General Mills, Nestlé, Mars, Kellogg, Proctor & Gamble, and Johnson & Johnson. In 1965, these corporations posed the hypothesis that processed food is better than real food. To determine if the experiment was a success or a failure, we have to examine the outcome variables. In this case, there are 4: food consumption, health/disease, environment, and cash flow, divided into companies, consumers, and society.

Processed food is defined by 7 food engineering criteria; it is mass produced, is consistent batch to batch, is consistent country to country, uses specialized ingredients from specialized companies, consists of prefrozen macronutrients, stays emulsified, and has long shelf life or freezer life.<sup>1</sup>

Furthermore, 11 nutritional properties distinguish processed food.<sup>2</sup> (1) Too little fiber. When fiber (soluble and insoluble) is consumed within food, it forms a gelatinous barrier along the intestinal wall. This delays the intestine's ability to absorb nutrients, instead feeding the gut microbiome. Attenuation of the glucose rise results in insulin reduction. Attenuation of fructose absorption reduces liver fat accumulation. (2) and (3) Too few  $\omega$ -3 and too many  $\omega$ -6 fatty acids.  $\omega$ -3s are precursors to docahexaenoic and eicosapentanoic acids (anti-inflammatory). Conversely,  $\omega$ -6s are precursors of arachidonic acid (proinflammatory). Our ratio of  $\omega$ -6 to  $\omega$ -3 fatty acids should be approximately 1:1. Currently, our ratio is about 25:1, favoring a proinflammatory state, which can drive oxidative stress and cell damage. (4) Too few micronutrients. Antioxidants, such as vitamins C and E, quench oxygen radicals in peroxisomes to prevent cellular damage, while others, such as carotenoids and  $\alpha$ -lipoic acid, prevent lipid peroxidation. (5) Too many

# Impact: Walnut Creek Spotlight - 3rd Silver Level District



## Eat Real Featured Meal

### Housemade Baked Ziti

Served with 100% whole grain pasta & freshly prepared marinara sauce



**Plain milk** is nutrient rich and contains no added sugar.

**Why this matters**  
Excess sugar negatively impacts your ability to learn.

**Marinara sauce** is made from scratch using minimally processed ingredients.

**Why this matters?**  
This sauce is filled with nutritious whole food ingredients & does not contain any added sugar or other harmful additives found in pre-made sauces.

Served with **100% whole grain pasta**.

**Why this matters?**  
Whole grain pasta contains fiber to support healthy digestion & is packed with micro nutrients to grow a healthy body.

Seasonal strawberries and kiwis are sourced locally from **Watsonville** and **Gridley** respectively.

**Why this matters?**  
Local sourcing of produce helps support businesses in our community and the planet's health.

The **salad bar** is stocked with a variety of fresh, local vegetables, including carrots from **Bakersfield** and romaine for Caesar salad from **Salinas**.

**Why this matters**  
Salad bars with fresh, local produce provide the opportunity to try a variety of fruits & vegetable

This meal showcases the values of our Eat Real Certification!  
Learn more at [www.eatreal.org/walnut-creek-is-certified](http://www.eatreal.org/walnut-creek-is-certified).

## WCSD Eat Real Certification Highlights

- ★ **66%** of produce is sourced locally (34% increase from 2019)
- ★ Removed an average of **7 lbs** of added sugar per student per year from breakfast grains alone
- ★ Nothing on menu contains more than 3 tsp of added sugar
- ★ Increased plant-based menu options
  - From 0 to 5 at K-5 and K-8 sites
  - From 1 to 7 at 6-8 sites
- ★ Saw lunch participation increase by **73%** and breakfast by **2400%** from 2019 to 2023



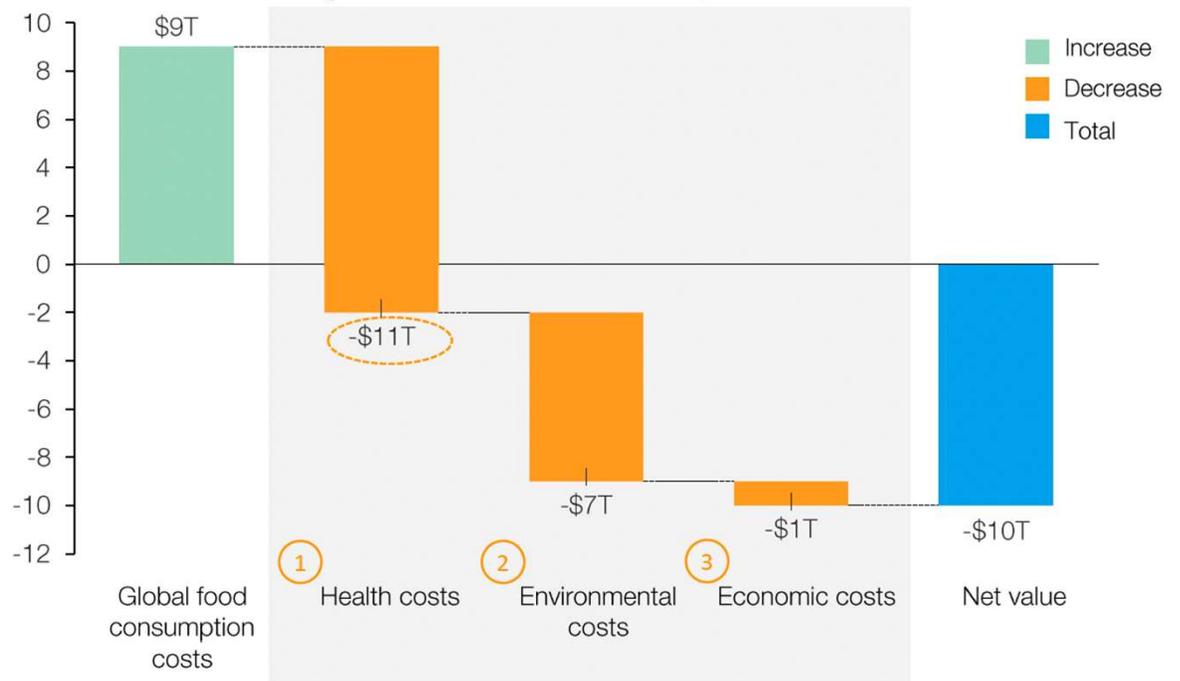
## Prospects for the true cost accounting of food systems

Evaluating food systems in a holistic way is paramount to their transformation. Recent initiatives show how true cost accounting can help achieve that transformation at policy, product, organizational, farm, and investment levels.

Lauren Baker, Guillermo Castilleja, Adrian De Groot Ruiz and Adele Jones

Ultraprocessed foods are only “cheap” when the costs of their negative metabolic impact are externalized to health care and public health budgets.

Measuring the Current and Hidden Costs of Today’s Food  
(global estimates for 2021 in \$ trillions)



# What Good Nutrition Needs To Do to Improve Metabolic Health

- **The science is clear:**

- more soluble and insoluble fiber (to feed the gut)
- more  $\alpha$ -linolenic acid, EPA, DHA, micronutrients (to support the brain)
- less sugar (to protect the liver)

- **A Real Food Diet**

- **Can the food industry re-engineer its current practices?**

## Forum

# Eliminate or reformulate ultra-processed foods? Biological mechanisms matter

Deirdre K. Tobias<sup>1,2</sup> and Kevin D. Hall<sup>3,\*</sup>

<sup>1</sup>Division of Preventive Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA

<sup>2</sup>Nutrition Department, Harvard T.H. Chan School of Public Health, Boston, MA, USA

<sup>3</sup>Laboratory of Biological Modeling, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, USA

\*Correspondence: [kevinh@niddk.nih.gov](mailto:kevinh@niddk.nih.gov)

<https://doi.org/10.1016/j.cmet.2021.10.005>

Increased ultra-processed foods (UPFs) in the food supply  
and related chronic diseases. To address this public health  
challenge, the elimination of UPF categories will require improved  
regulation. UPFs lead to overconsumption and poor health.

10/18/21, 1:30 PM

'Intake of added and free sugars should be as low as possible': EFSA confirms sugar consumption a risk factor in chronic diseases

FOOD  
navigator.com

## 'Intake of added and free sugars should be as low as possible': EFSA confirms sugar consumption a risk factor in chronic diseases

By Katy Askew 

22-Jul-2021 - Last updated on 22-Jul-2021 at 15:46 GMT

# Can technology help, and turn a profit?

- **Ingredients**

- Primary – low or no calorie sugars/sweeteners
- Secondary – non sugar / sweetener ingredients
- Healthy Fats (functional and supplemental)
- Dairy-based ingredients

- **Processing**

- Filtering out sugar
- Enzymes that eat glucose and fructose
- Fiber products
- Caramelizing or other processing techniques
- Optimizing lactose/fat/protein content
- Fruit flavored beverages with no calories

- **Packaging**

- Juice in functional “shots,” supplemented with vitamins, minerals, and fiber

- **Data Science**

- Recommendation engine
- Procurement and distribution model



# The Metabolic Matrix: Re-engineering ultraprocessed foods to feed the gut, protect the liver, and support the brain

Timothy S. Harlan<sup>1\*</sup>, Rachel V. Gow<sup>2</sup>, Andreas Kornstädt<sup>3</sup>,  
 P. Wolfram Alderson<sup>4</sup> and Robert H. Lustig<sup>5</sup>

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 National Institutes of Health,

- Sugar reduction
- Non-nutritive sweeteners
- Fats
- Fiber
- Dairy-based ingredients
- Processing
- Packaging
- Food data science



An Actionable Idea by a Member of the World Economic Forum's Regional Action Group for the Middle East and North Africa

Call to action

This Actionable Idea is a call to action, contributing to:

**Action 1: Principles of Stakeholder Capitalism for the Middle East and North Africa**

**Principle 5: Mitigating global health risks**  
 Governments and the private sector are called upon to cooperate on a regional level in order to mitigate the impact of global health risks affecting their populations, as well as guest workers, and collaborate in such areas as research and development, digital health, and vaccine development and distribution.

**Action 2: UN Sustainable Development Goals**

- UN SDG3: Ensure healthy lives and promote well-being for all at all ages
- UN SDG12: Ensure sustainable consumption and production patterns

A new paradigm: health meets food

"Metabolic health" – the primary marker and outcome of nutritional security – needs to be re-conceptualized as a fundamental organizing principle to drive food system change. To achieve this outcome, the Kuwaiti Danish Dairy (KDD) company, currently working with an independent, evidence-based food re-engineering team, seeks the support of stakeholders from the Regional Action Group for the Middle East and North Africa to champion

this prototype and bring it to the United Nations Food Systems Summit and other international fora as an example of how a metabolic paradigm shift is not only possible, but necessary.

To work towards this outcome, **the metabolic matrix** developed by KDD proposes a scalable and replicable prototype for fundamentally shifting the basis for making commercial food and beverage products, built upon a new and safe paradigm of food processing that promotes metabolic health.

FIGURE 1: KDD product metabolic matrix



🔑 The key to understanding chronic disease is that there are not four separate problems – nutrition, metabolism, inflammation, immunity; there's only one, but they are all related.

Robert H. Lustig, Professor Emeritus of Pediatrics, Division of Endocrinology, University of California, San Francisco (UCSF), USA

What is "food re-engineering"?

Food re-engineering is the scientific approach to creating foods with metabolically supportive ingredients and processes. The science behind such an approach looks beyond the product to health outcomes, crafting functional foods that are designed to protect our health, economy and the environment. Linking good food, metabolism and health reduces or eliminates preventable, diet-related diseases and the burdensome financial burdens they foster.

TABLE 3 Product and Ingredient Testing (Eurofins).

Macronutrients	Vitamins	Micronutrients	Heavy metals	Other
Omega-3 polyunsaturated fatty acids	Vitamin A (Retinol)	Choline	Lead	Anthocyanins
Saturated Fats	Vitamin A (Beta Carotene)	Sodium	Arsenic	Polyphenols
Omega-6 polyunsaturated fatty acids	Vitamin D	Copper	Cadium	Flavonoids
Transfats	Vitamin E (Tocopherol Profile)	Magnesium	Mercury	Glyphosate
Total protein	Vitamin C (Ascorbic Acid)	Maganese		Colony Forming Units (CFUs)
Amino acid profile	Vitamin B1 (Thiamine)	Iodine		Juice Authenticity
Sugar profile	Vitamin B2 (Riboflavin)	Iron		
Fiber profile	Niacin	Phosphorus		
	Vitamin B5 (Pantothenic Acid)	Potassium		
	Vitamin B6 (Pyridoxine)	Selenium		
	Vitamin B12	Zinc		
	Total folate	Calcium		

# New Products on the Shelves in Kuwait

A

original

Nutrition Facts	
servings per container	
<b>Serving size</b>	<b>(106g)</b>
Amount per serving	
<b>Calories</b>	<b>80</b>
	% Daily Value*
Total Fat 2g	3%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 5mg	2%
Sodium 75mg	3%
Total Carbohydrate 12g	4%
Dietary Fiber 1g	4%
Total Sugars 11g	
Includes 7g Added Sugars	14%†
<b>Protein 3g</b>	
Vitamin D 2.2mcg	10%
Calcium 110mg	8%
Iron 0.3mg	2%
Potassium 190mg	4%

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

WATER, COW'S SKIMMED MILK POWDER, SUCROSE, ALKALIZED COCOA POWDER, MILK FAT, EMULSIFIER AND STABILIZER (MONO- AND DIGLYCERIDES OF FATTY ACIDS E471, CARRAGEENAN E407, GUAR GUM E412), SODIUM CHLORIDE, VANILLA FLAVORING ((53%) PROPYLENE GLYCOL E1520, (27.4%) WATER, (8.9%) SUCROSE, (3%) GLYCERINE E422, (1%) INVERT SUGAR, FLAVORING SUBSTANCES, FLAVORING PREPARATIONS), VITAMIN A (VITAMIN A ACETATE), VITAMIN D3 (CHOLECALCIFEROL)

re-engineered

Nutrition Facts	
servings per container	
<b>Serving size</b>	<b>(106g)</b>
Amount per serving	
<b>Calories</b>	<b>50</b>
	% Daily Value*
Total Fat 2g	3%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 5mg	2%
Sodium 75mg	3%
Total Carbohydrate 13g	5%
Dietary Fiber 1g	4%
Total Sugars 4g	
Includes 0g Added Sugars	0%†
Sugar Alcohol 8g	
<b>Protein 3g</b>	
Vitamin D 0mcg	0%
Calcium 110mg	8%
Iron 0.3mg	2%
Potassium 190mg	4%

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

WATER, COW'S SKIMMED MILK POWDER, ERYTHRITOL, ALKALIZED COCOA POWDER, MILK FAT, STABILIZER (ACACIA GUM E414, GELLAN GUM E418), SODIUM CHLORIDE, VANILLA FLAVORING ((53%) PROPYLENE GLYCOL E1520, (27.4%) WATER, (8.9%) SUCROSE, (3%) GLYCERINE E422, (1%) INVERT SUGAR, FLAVORING SUBSTANCES, FLAVORING PREPARATIONS), SWEETENER (STEVIA)

B

original

Nutrition Facts	
servings per container	
<b>Serving size</b>	<b>(100g)</b>
Amount per serving	
<b>Calories</b>	<b>200</b>
	% Daily Value*
Total Fat 10g	13%
Saturated Fat 9g	45%
Trans Fat 0g	
Cholesterol 5mg	2%
Sodium 40mg	2%
Total Carbohydrate 24g	9%
Dietary Fiber 0g	0%
Total Sugars 21g	
Includes 16g Added Sugars	32%†
<b>Protein 3g</b>	
Vitamin D 0mcg	0%
Calcium 90mg	6%
Iron 0.7mg	4%
Potassium 290mg	6%

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

WATER, SUCROSE, FULLY HYDROGENATED COCONUT OIL, COW'S SKIMMED MILK POWDER, ALKALIZED COCOA POWDER, SWEET WHEY POWDER (FROM COW'S MILK), MILK FAT, STABILIZER (VEGETABLE MONO- AND DIGLYCERIDES OF FATTY ACIDS E 471, LOCUST BEAN GUM E410, GUAR GUM E412)

re-engineered

Nutrition Facts	
servings per container	
<b>Serving size</b>	<b>(100g)</b>
Amount per serving	
<b>Calories</b>	<b>140</b>
	% Daily Value*
Total Fat 10g	13%
Saturated Fat 7g	35%
Trans Fat 0g	
Cholesterol 20mg	7%
Sodium 45mg	2%
Total Carbohydrate 22g	8%
Dietary Fiber 0g	0%
Total Sugars 6g	
Includes 0g Added Sugars	0%†
Sugar Alcohol 7g	
<b>Protein 4g</b>	
Vitamin D 0mcg	0%
Calcium 100mg	8%
Iron 0.7mg	4%
Potassium 310mg	6%

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

WATER, MILK FAT, COW'S SKIMMED MILK POWDER, ERYTHRITOL, STABILIZER (POLYDEXTROSE E1200), ALKALIZED COCOA POWDER, SWEET WHEY POWDER (FROM COW'S MILK), MONK FRUIT JUICE CONCENTRATE, MODIFIED WAXY MAIZE FOOD STARCH (E1412), STABILIZER (VEGETABLE MONO- AND DIGLYCERIDES OF FATTY ACIDS E 471, LOCUST BEAN GUM E410, GUAR GUM E412), SWEETENER (STEVIA)

FIGURE 1

XXX

# **Strategies for Advancing Metabolic Health**

**Public Health Intervention  
(one population at a time)**

**Personal Intervention  
(one patient at a time)**

**Technological Innovation  
(one company at a time)**