



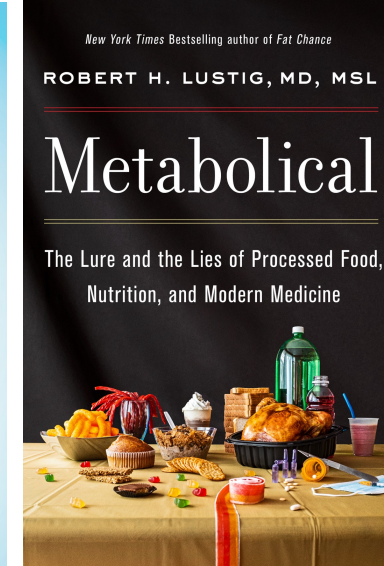
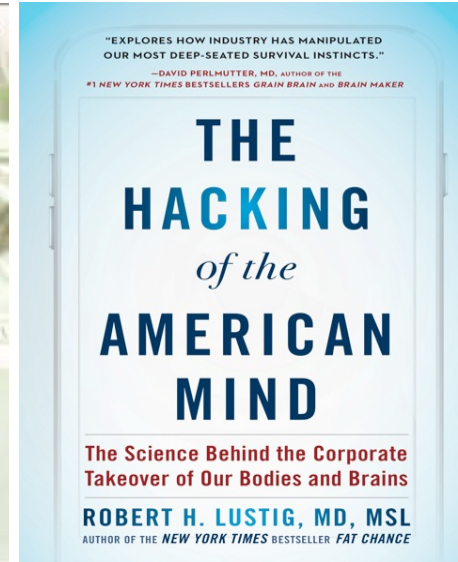
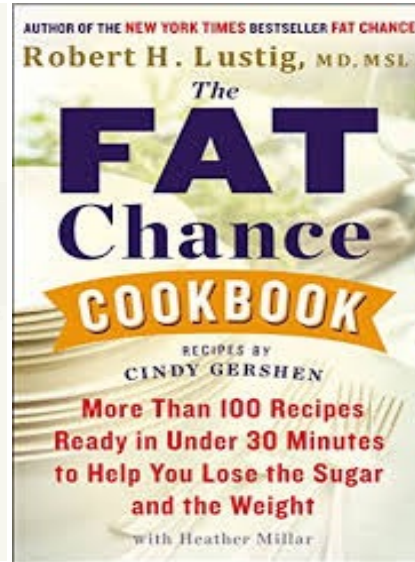
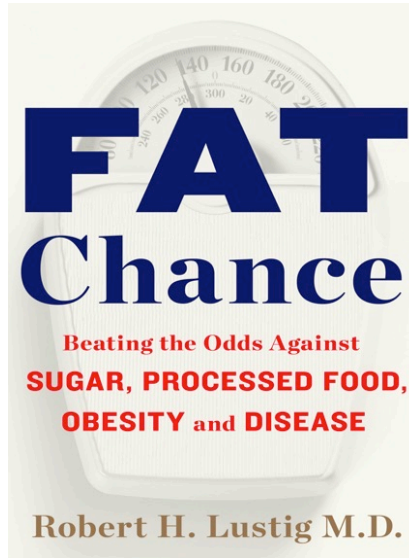
# The True Purpose Of Nutrition

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

LISPEN, Plainview, NY, Oct 24, 2023



# Disclosures



Chief Medical Officer:  
Kalin Health  
BioLumen  
Foogal  
Perfact

Paid Advisor:  
Myka Bio  
Journeys Metabolic  
Simplex Health  
Levels Health

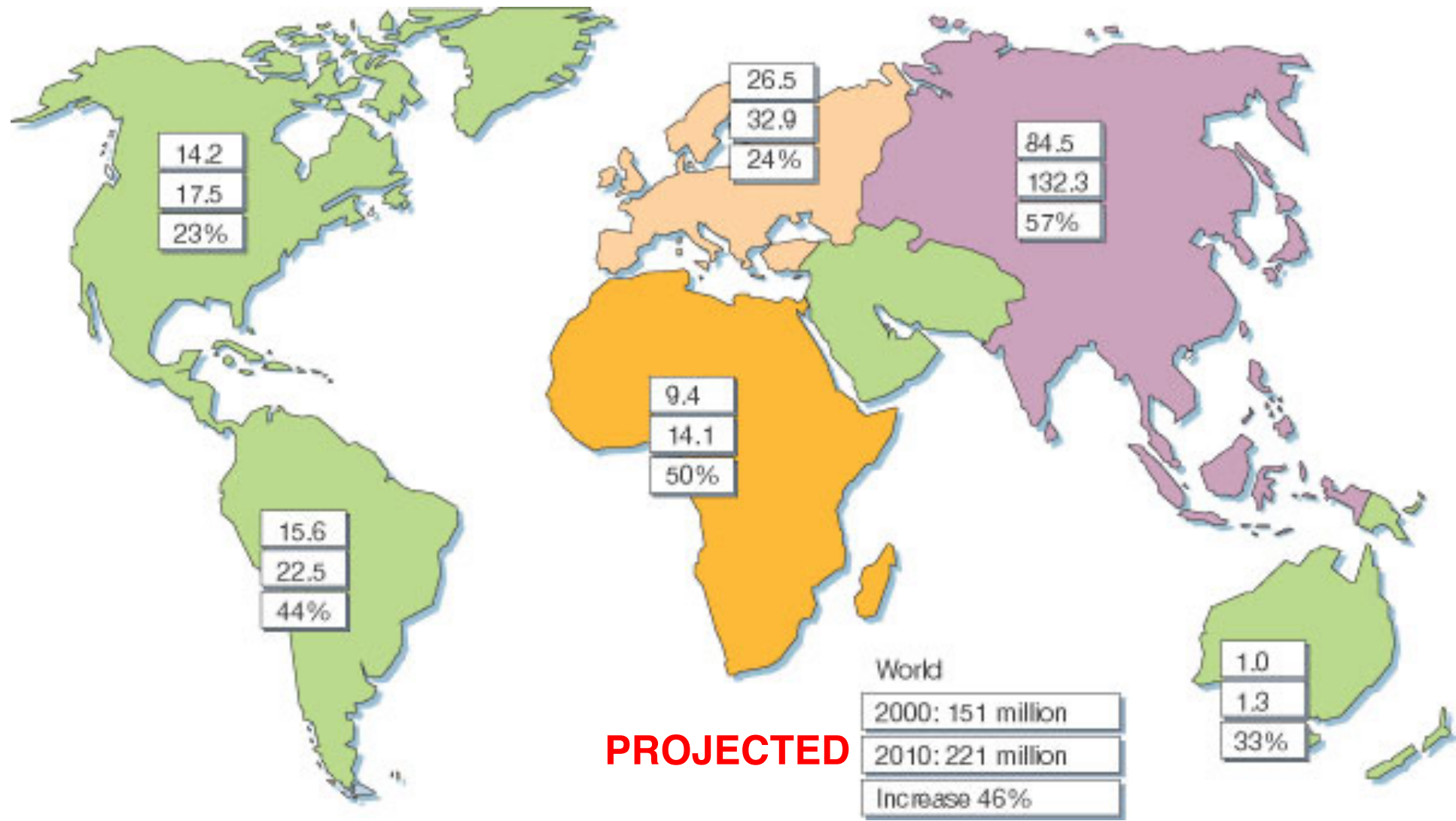
Unpaid Advisor:  
Kuwaiti Danish Dairy

# Learning Objectives

- To explain the subcellular pathologies that drive chronic disease, and how food can make each one worse or better
- To explain how exercise does not mitigate these pathologies
- To discern the associations between ultraprocessed food and both metabolic health and mental health
- To explain the precepts of good nutrition
  - feed the gut
  - protect the liver
  - support the brain

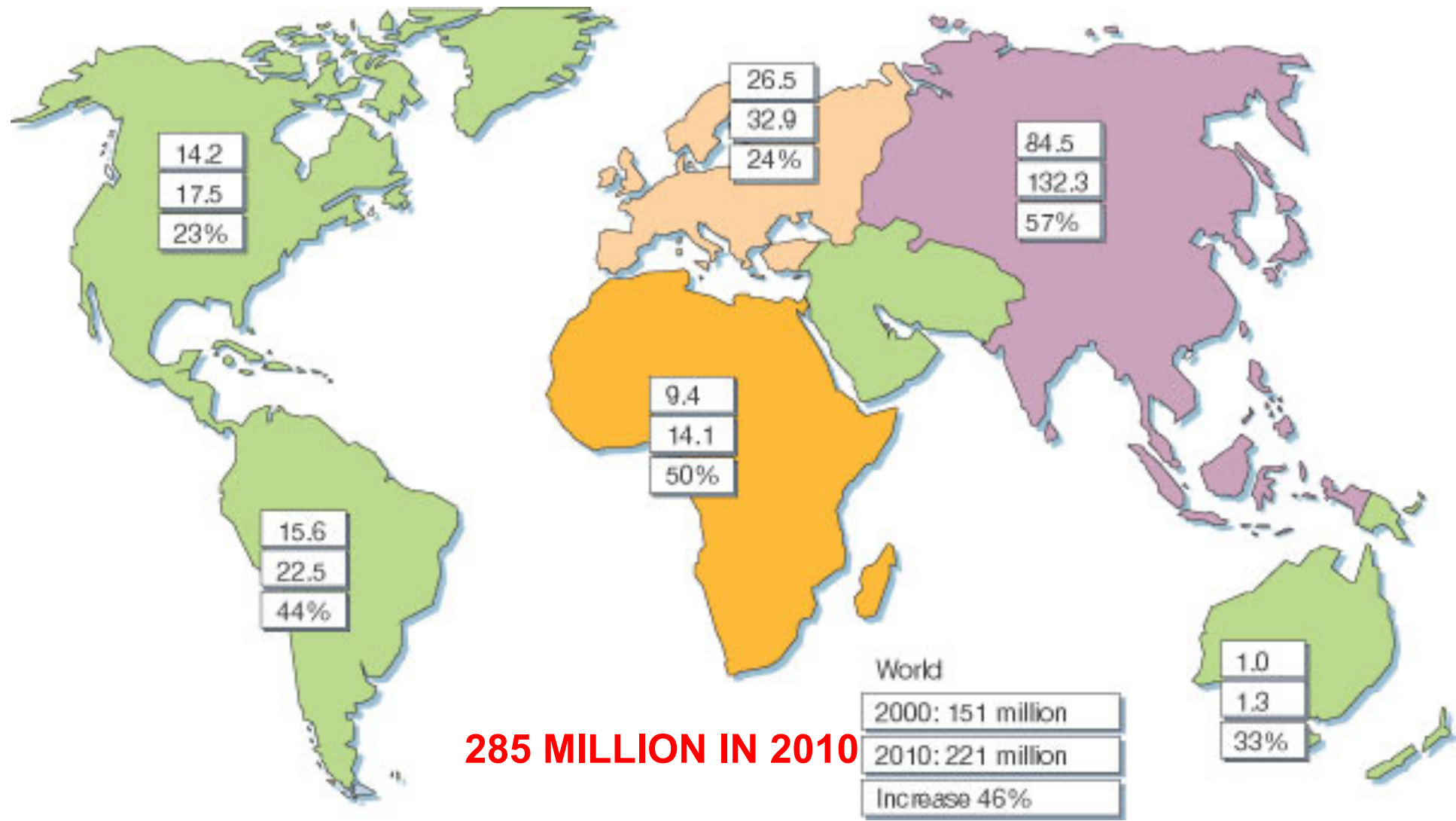


# T2DM increasing around the world

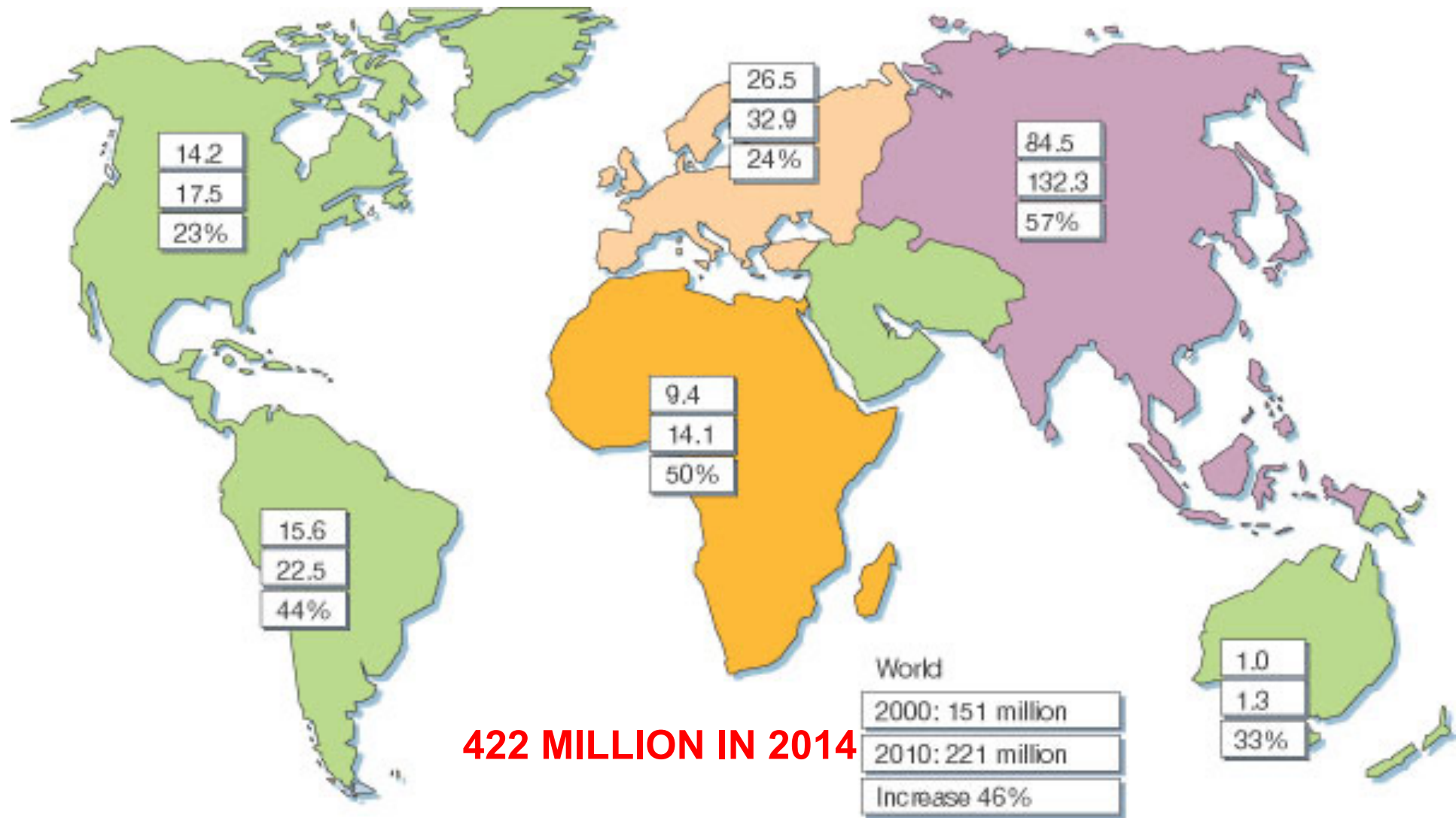




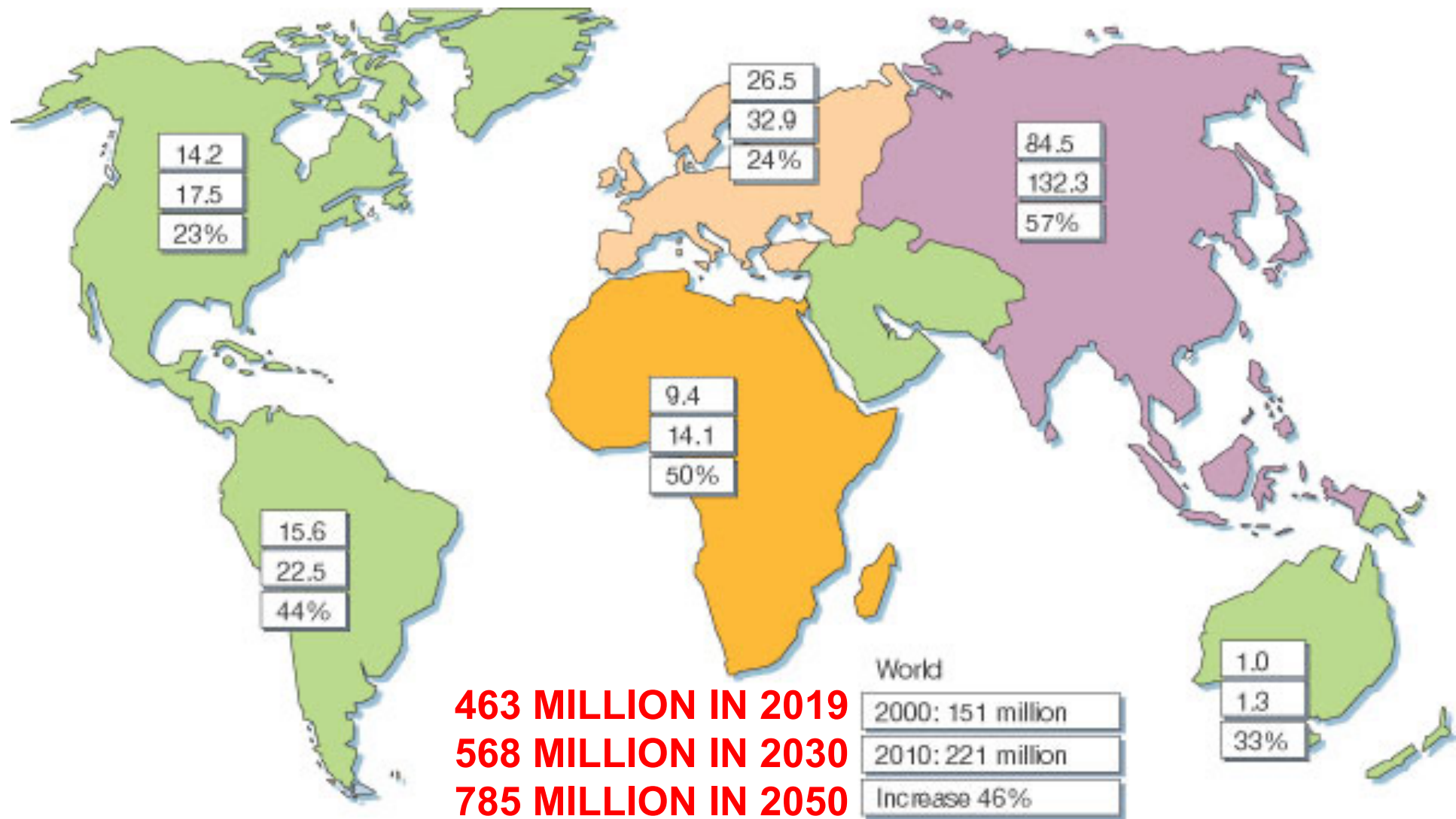
# T2DM increasing around the world



# T2DM increasing around the world



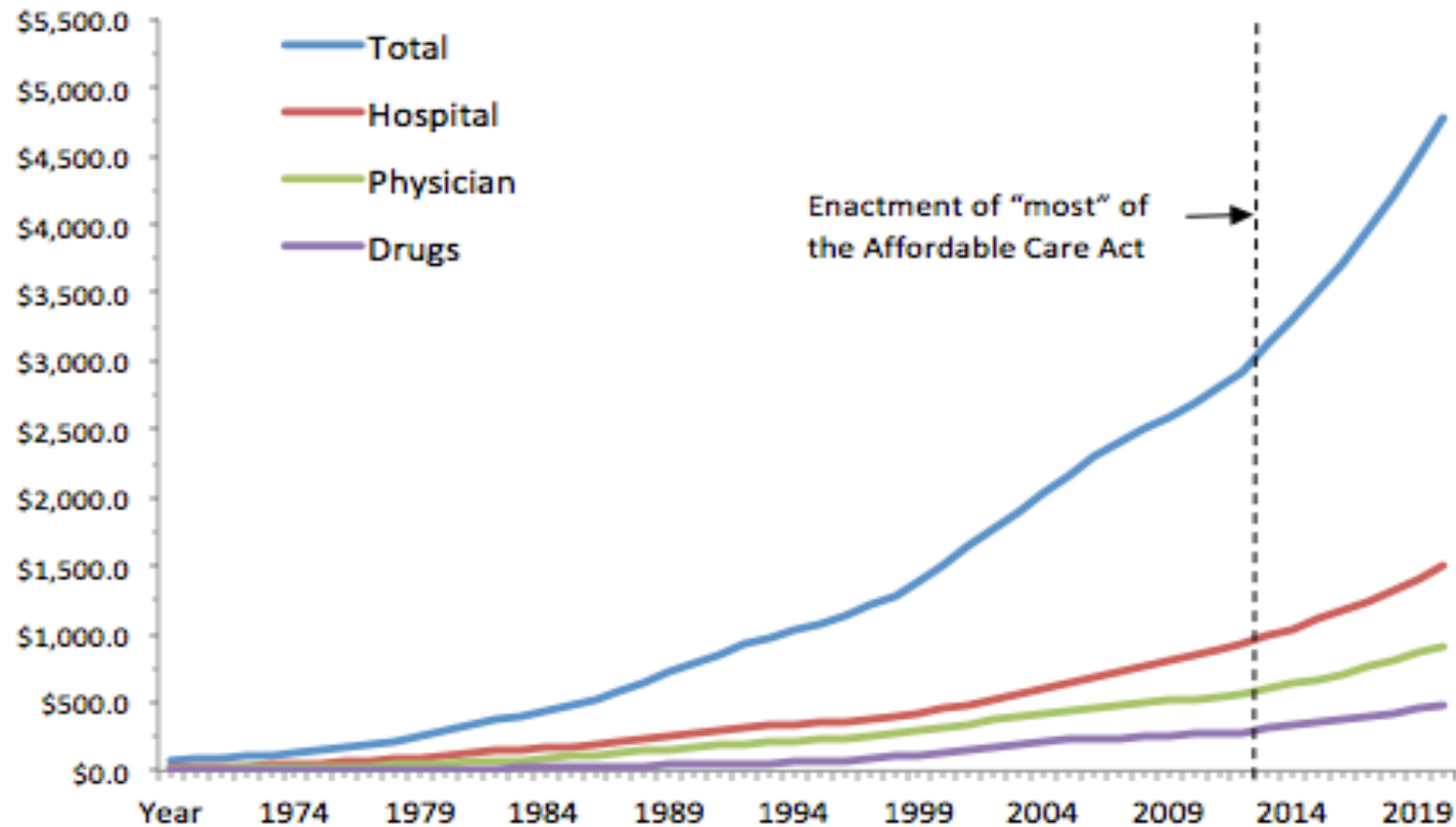
# T2DM increasing around the world





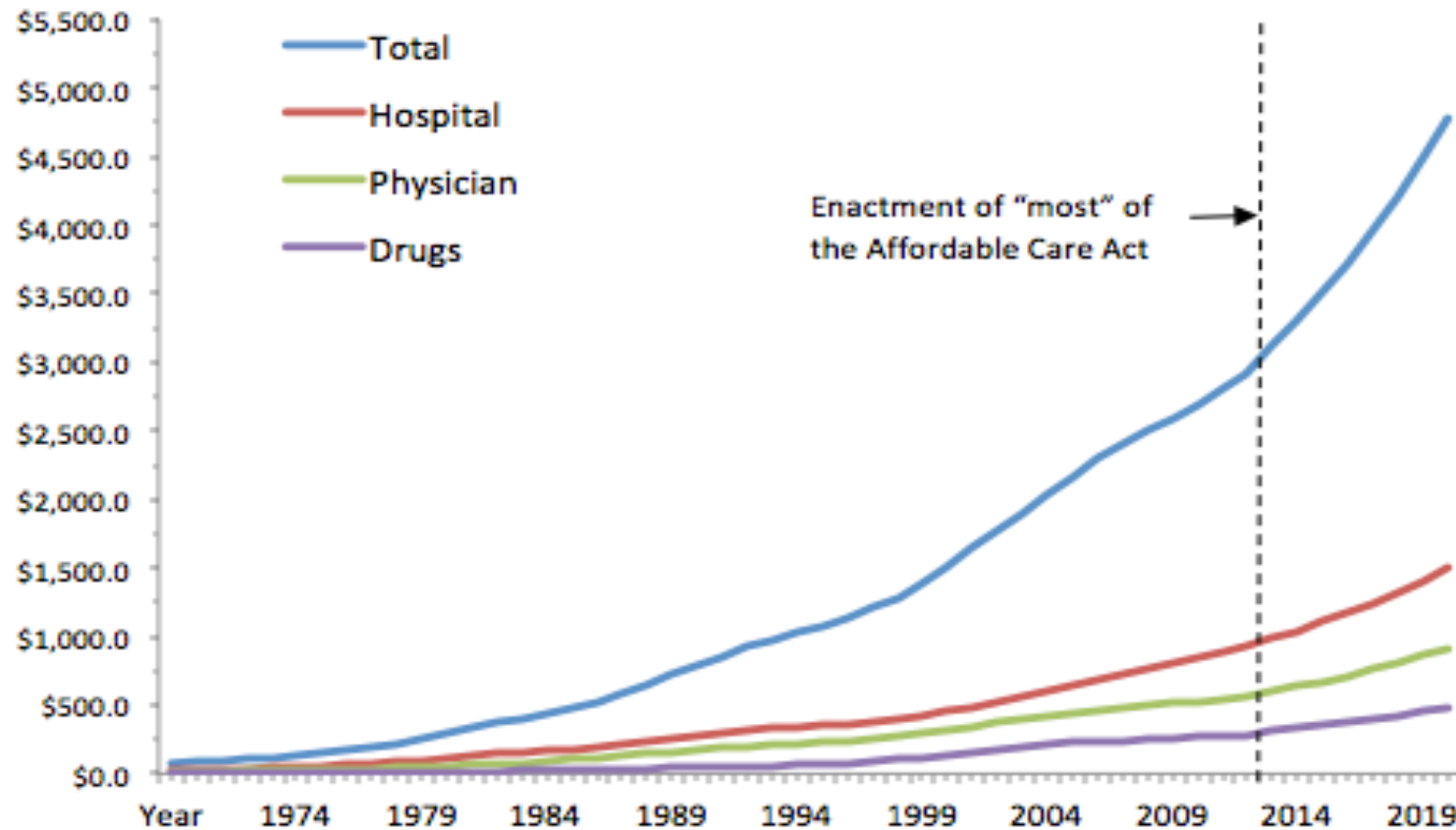
# The money is not going to hospitals, physicians, or Big Pharma

**Trends and Projections in U.S. Health Care Costs: 1970-2021 (in billions U.S. \$)**



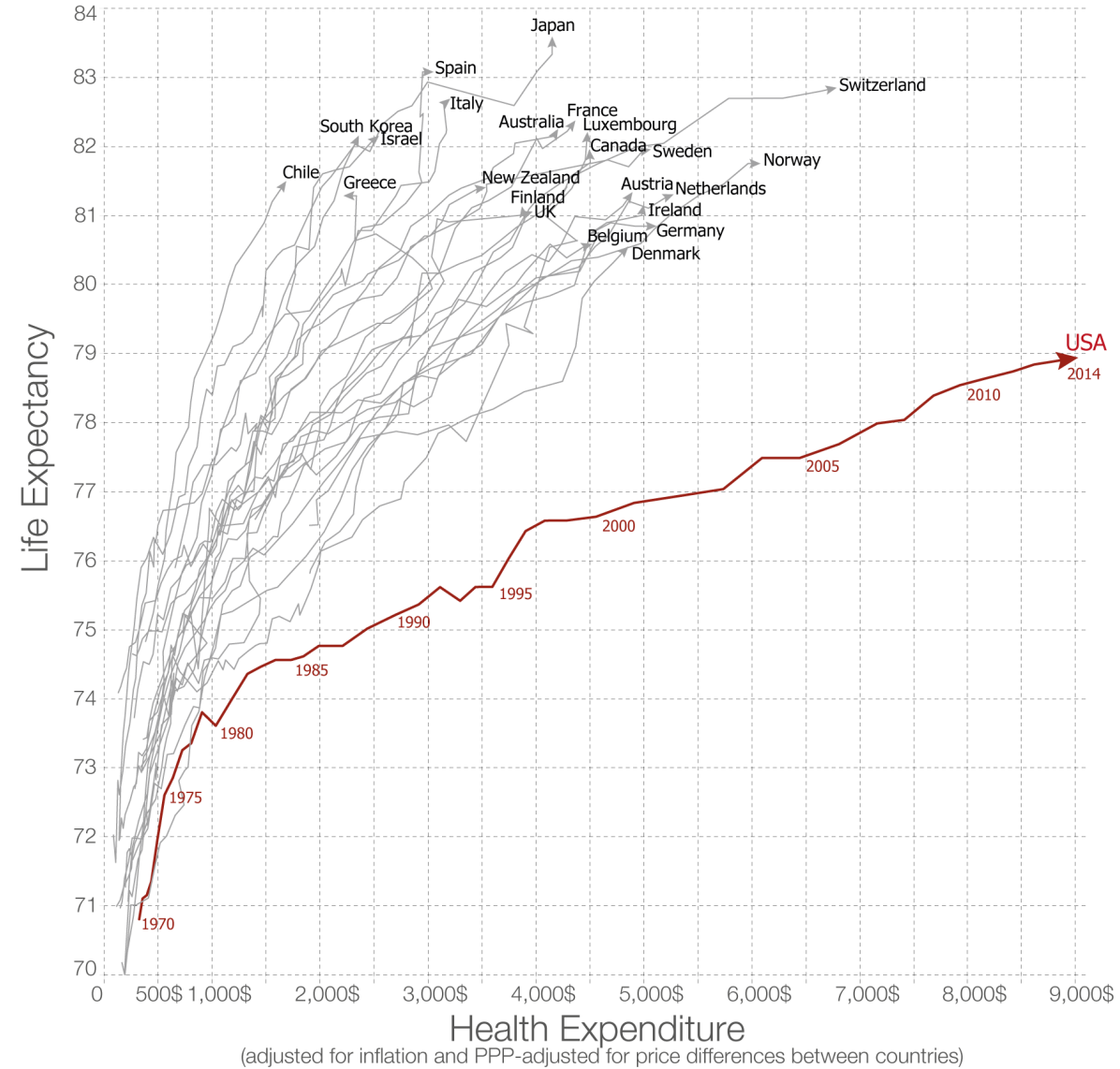
The money is not going to hospitals, physicians, or Big Pharma  
It's going to chronic metabolic disease

**Trends and Projections in U.S. Health Care Costs: 1970-2021 (in billions U.S. \$)**



# Life expectancy vs. health expenditure over time (1970-2014)

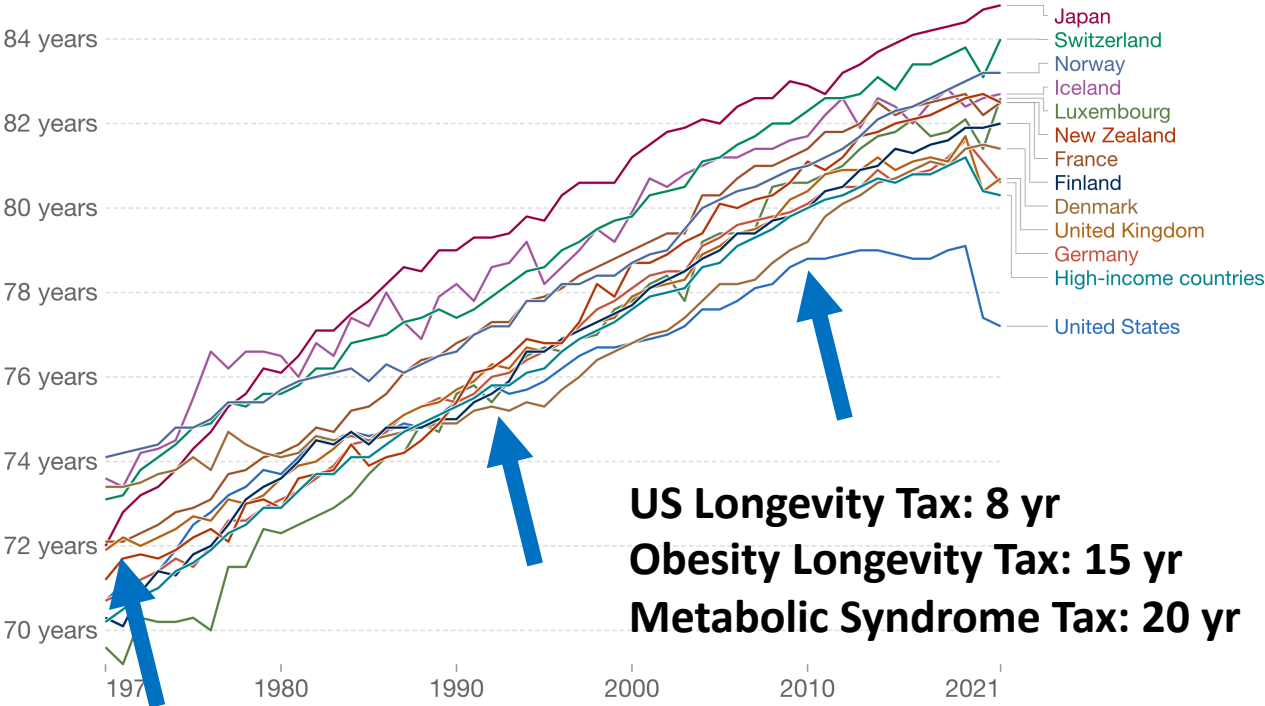
Health spending measures the consumption of health care goods and services, including personal health care (curative care, rehabilitative care, long-term care, ancillary services and medical goods) and collective services (prevention and public health services as well as health administration), but excluding spending on investments. Shown is total health expenditure (financed by public and private sources).





# Life expectancy, 1970 to 2021

Our World  
in Data



Source: UN WPP (2022); Zijdemann et al. (2015); Riley (2005)  
OurWorldInData.org/life-expectancy • CC BY  
Note: Shown is the 'period life expectancy'. This is the average number of years a newborn would live if age-specific mortality rates in the current year were to stay the same throughout its life.



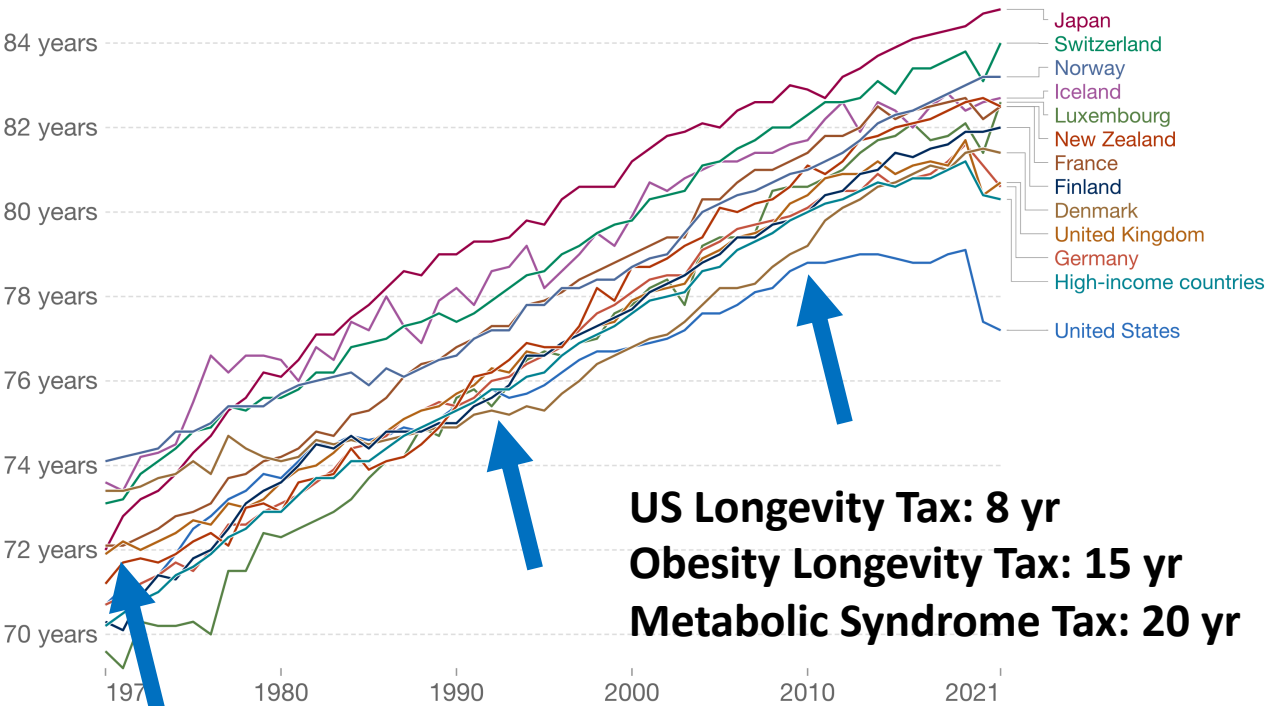
FOOD & NUTRITION

# Only 7% of American Adults Have Good Cardiometabolic Health

Tufts researchers find that most U.S. adults rate poorly across five components of heart and metabolic health, with clear racial disparities



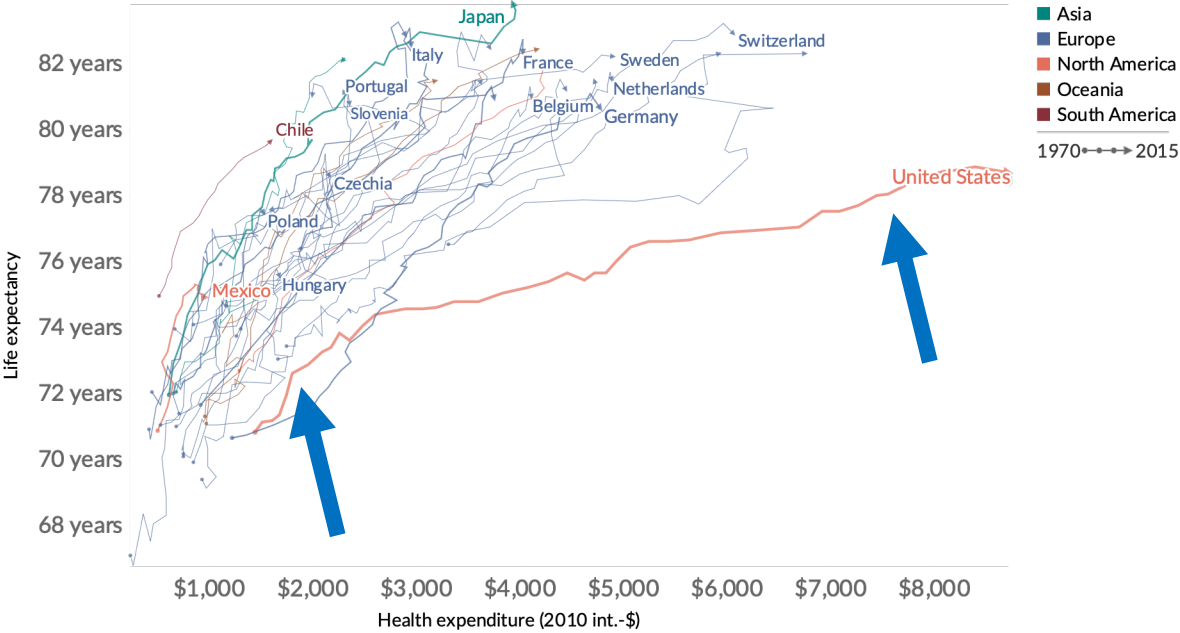
Life expectancy, 1970 to 2021



Source: UN WPP (2022); Zijdemann et al. (2015); Riley (2005) OurWorldInData.org/life-expectancy • CC BY  
Note: Shown is the 'period life expectancy'. This is the average number of years a newborn would live if age-specific mortality rates in the current year were to stay the same throughout its life.

Life expectancy vs. health expenditure, 1970 to 2015

Health financing is reported as the annual per capita health expenditure and is adjusted for inflation and price level differences between countries (measured in 2010 international dollars).



Source: Data compiled from multiple sources by World Bank; Health Expenditure and Financing - OECDstat (2017) OurWorldInData.org/the-link-between-life-expectancy-and-health-spending-us-focus • CC BY



**DIVE BRIEF**

# Medicare insolvency still expected by 2026, unchanged by COVID-19, trustees say

Published Sept. 1, 2021



[Rebecca Pifer](#)

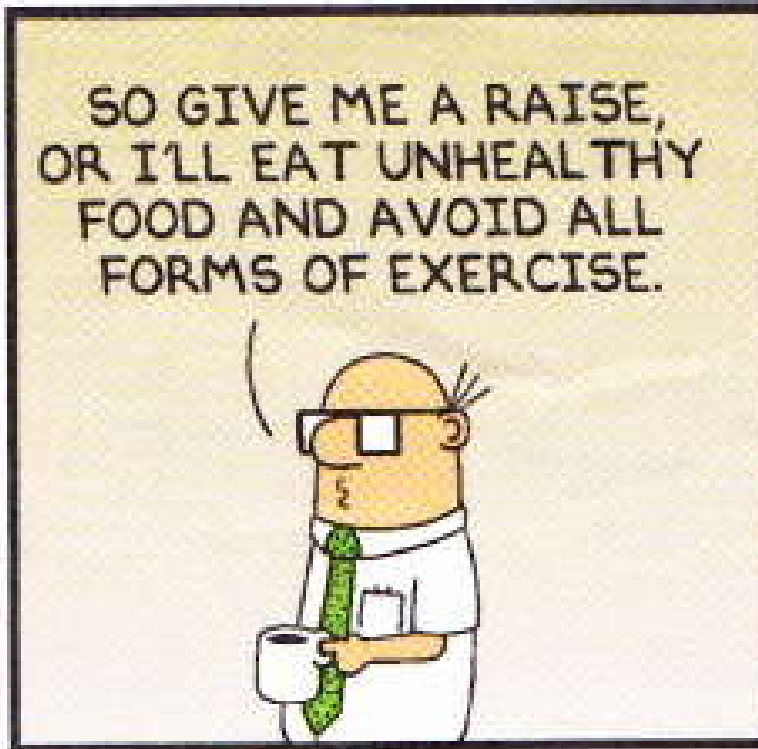
Senior Reporter





scottadams@aol.com

www.dilbert.com



8-4-08 © 2008 Scott Adams, Inc./Dist. by UFS, Inc.







# 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

# 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

# Definitions

- **Food Science:** What happens between the ground and the mouth
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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***

## **New Frontiers of Nutrition**

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

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

***Consultative Brief – March 2023***

## **New Frontiers of Nutrition**

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

**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)







# The Hateful (or Grateful) Eight

The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging



- 1. Glycation (carbon deposits)
- 2. Oxidative Stress (rusting)





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The Diseases That Aren't Diseases

Subcellular Pathologies that Belie Aging



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- 3. Mitochondrial Dysfunction (transmission)





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- 1. Glycation (carbon deposits)
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- 4. Insulin Resistance (carburetor)







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- 4. Insulin Resistance (carburetor)
- 5. Membrane Integrity (oil leak)
- 6. Inflammation (rotted fuel lines)
- 7. Methylation (spark plugs)





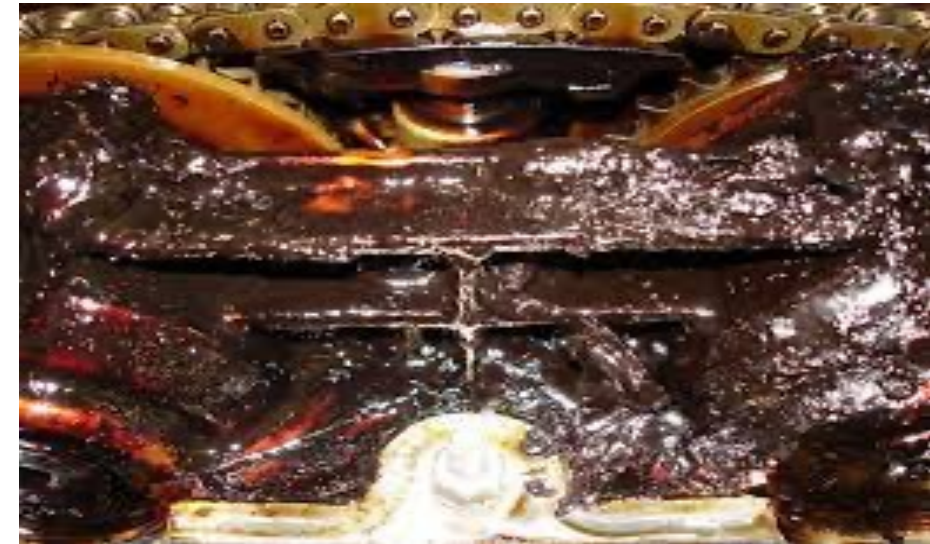
# The Hateful (or Grateful) Eight

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- 1. Glycation (carbon deposits)
- 2. Oxidative Stress (rusting)
- 3. Mitochondrial Dysfunction (transmission)
- 4. Insulin Resistance (carburetor)
- 5. Membrane Integrity (oil leak)
- 6. Inflammation (rotted fuel lines)
- 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”*



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.

---

TARA LAW

JAN 09, 2023 9:06 AM PST

**Is ultraprocessed food “food”?**

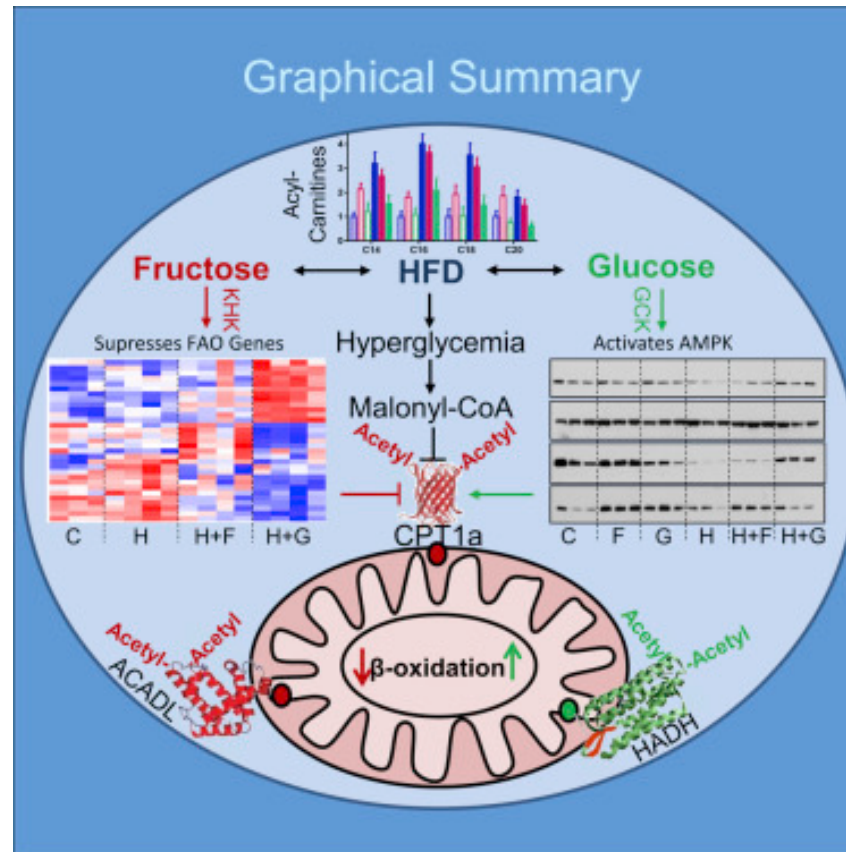
## Is ultraprocessed food “food”?

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



# Burning:

## Ultraprocessed food inhibits mitochondria

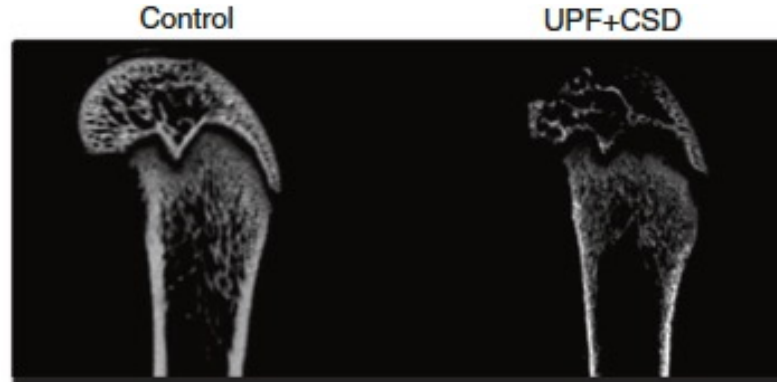


"The most important takeaway of this study is that high fructose in the diet is bad," says Dr. Kahn. "It's not bad because it's more calories, but because it has effects on liver metabolism to make it worse at burning fat. As a result, adding fructose to the diet makes the liver store more fat, and this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

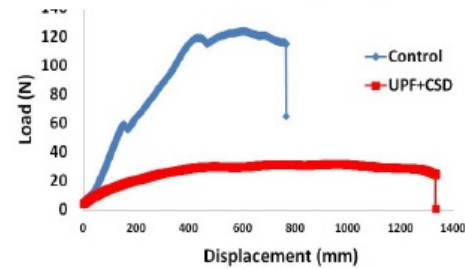
Dr. C. Ronald Kahn, CEO  
Joslin Diabetes Center

# Growth:

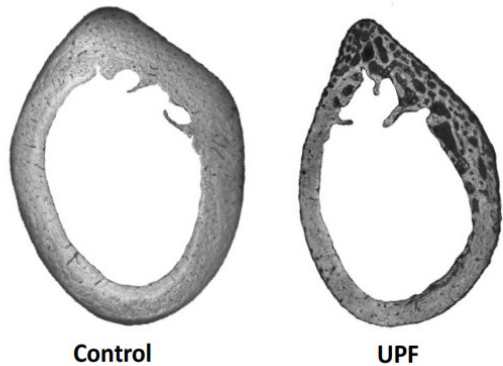
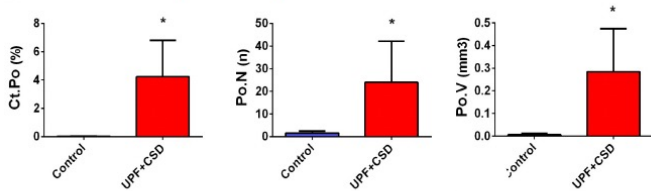
## Ultraprocessed food inhibits bone growth



D. Mechanical properties

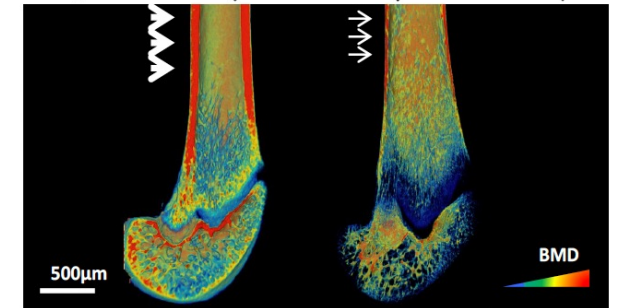
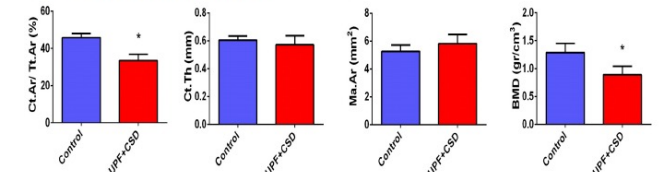


C. Cortical porosity

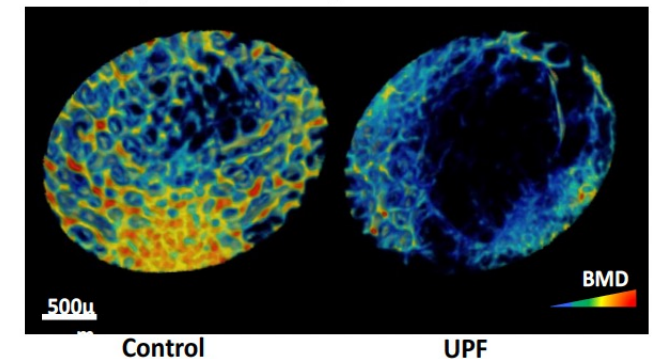
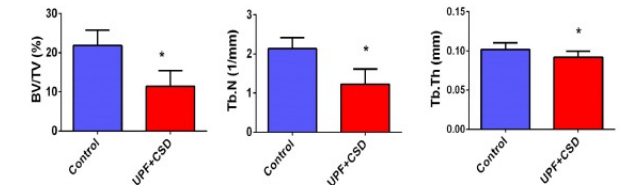


UPF: Ultraprocessed food  
CSD: Caloric soft drink

B. Cortical analysis



A. Trabecular analysis







Contents lists available at ScienceDirect

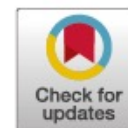
# Clinical Nutrition

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 Srouf <sup>k</sup>, Franziska Jannasch <sup>l, m, n</sup>, Matthias B. Schulze <sup>l, o</sup>, Giovanna Masala <sup>p</sup>, Sara Grioni <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>



*nutrients*



*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 Druet-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

*European Journal of Public Health*, Vol. 32, No. 5, 779–785


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

.....

# **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

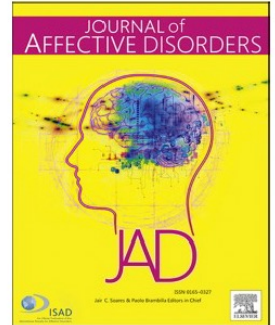
First published July 27, 2022, DOI: <https://doi.org/10.1212/WNL.0000000000200871>



Contents lists available at [ScienceDirect](#)

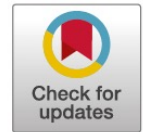
## Journal of Affective Disorders

journal homepage: [www.elsevier.com/locate/jad](http://www.elsevier.com/locate/jad)



### High ultra-processed food consumption is associated with elevated psychological distress as an indicator of depression in adults from the Melbourne Collaborative Cohort Study

Melissa M. Lane<sup>a,\*</sup>, Mojtaba Lotfaliany<sup>a</sup>, Allison M. Hodge<sup>b,c</sup>, Adrienne O'Neil<sup>a</sup>,  
Nikolaj Travica<sup>a</sup>, Felice N. Jacka<sup>a,d,e,f</sup>, Tetyana Rocks<sup>a</sup>, Priscila Machado<sup>g,h</sup>,  
Malcolm Forbes<sup>a,i,j</sup>, Deborah N. Ashtree<sup>a</sup>, Wolfgang Marx<sup>a</sup>



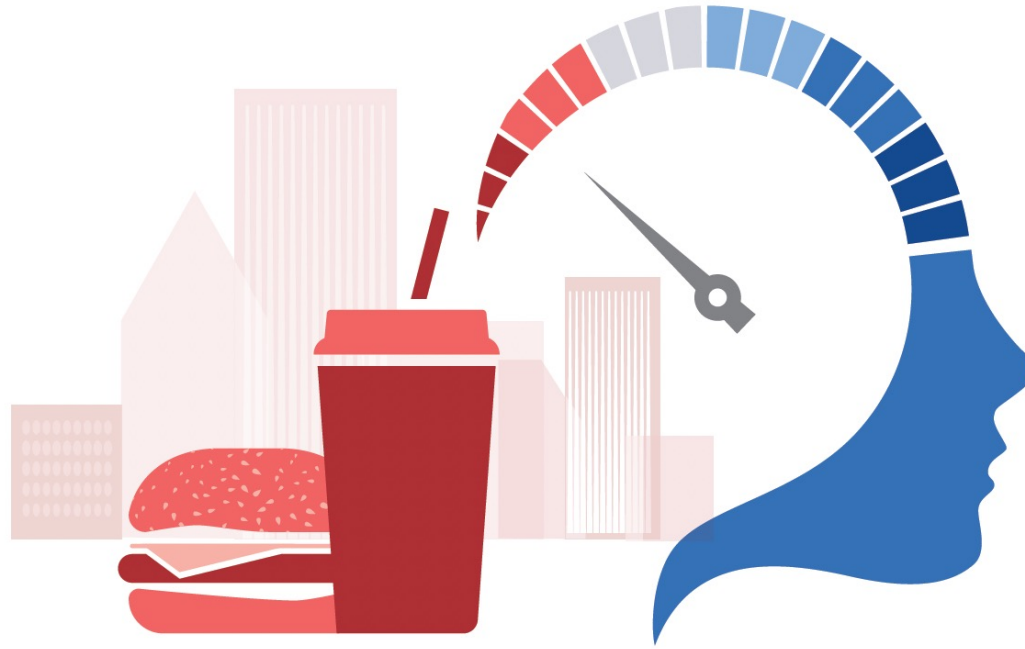


# American Journal of Preventive Medicine

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>

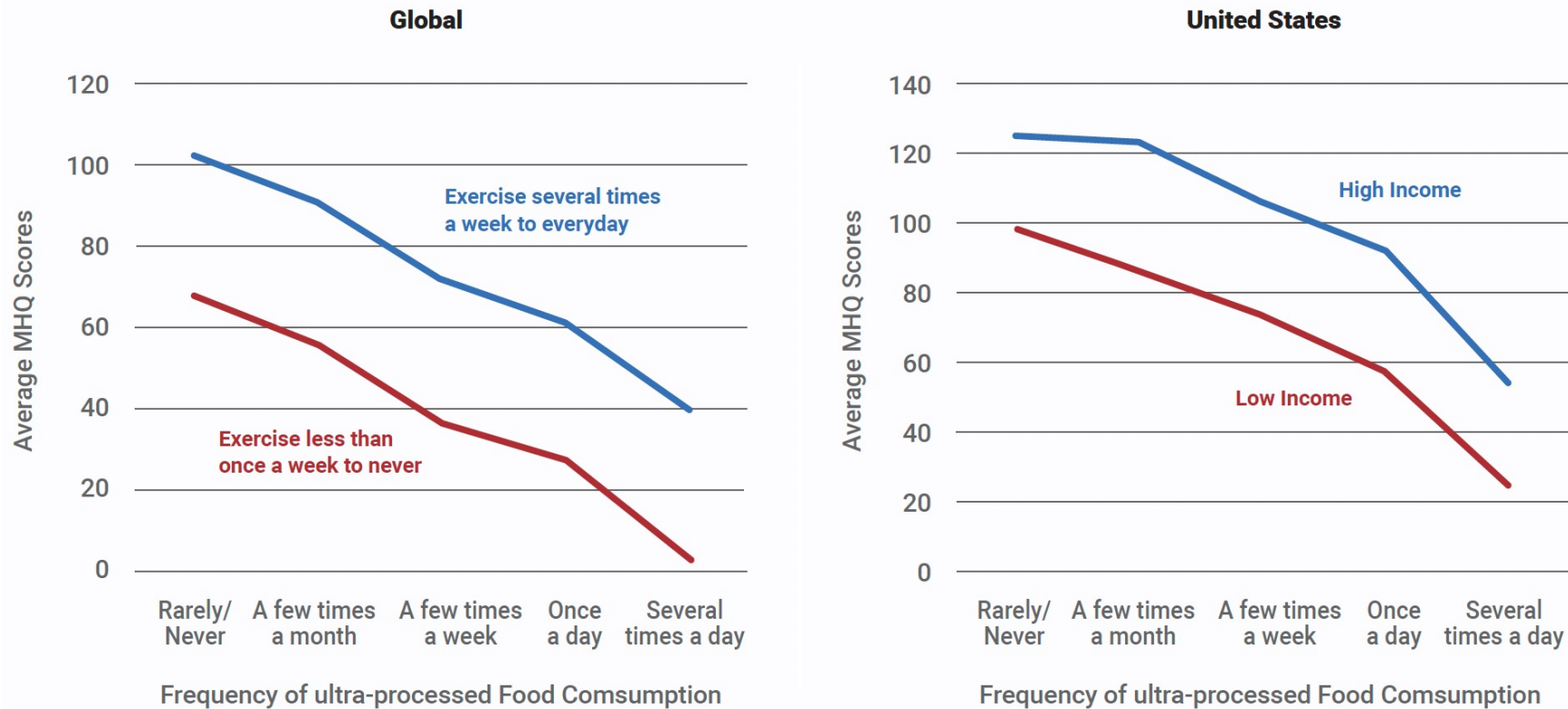


# Ultra-processed food consumption and mental wellbeing outcomes

# Global Mind Project (n = 227,000)

**Figure 3: Impact of ultra-processed food consumption for different levels of exercise and income**

*Relationship between MHQ scores and frequency of ultra-processed food consumptions for individuals who (i) exercise several times a week (blue line) or less than once a week to never (red line) for the global sample (left) and (ii) for those who are low income (<\$40,000 annually; red line) versus high income (>\$100,000 annually; blue line) for respondents in the United States (right)*



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



# Processed food and its role in nutritious and sustainable diets



## VIEWPOINT

**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](mailto:rlustig@ucsf.edu)).

## Processed Food—An Experiment That Failed

**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, Procter & 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.

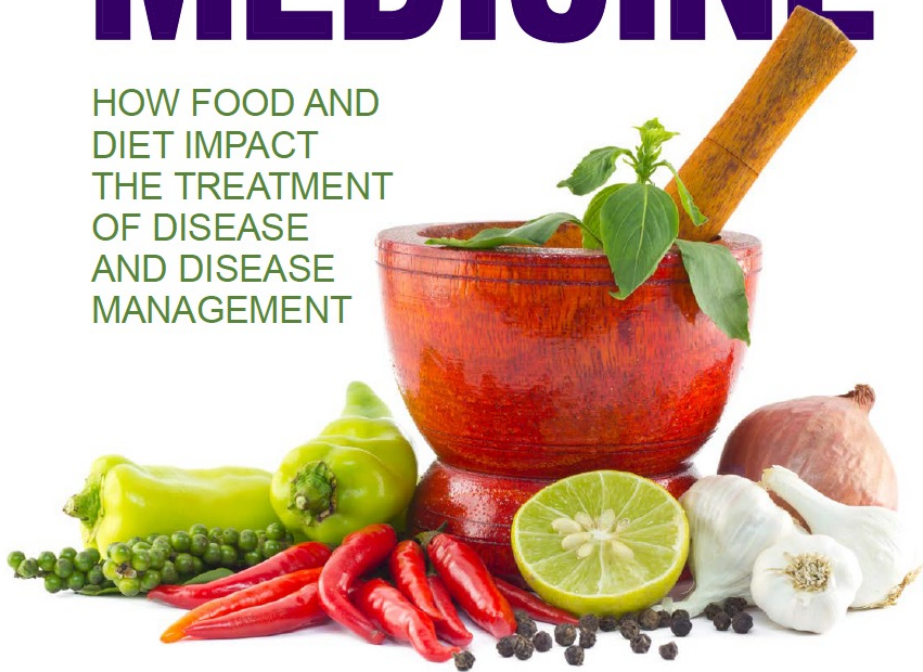
Processed food is defined by 7 food engineering criteria; it is mass produced, is consistent batch to batch, is consistent country to country, uses specialized ingredients from specialized companies, consists of prefrozen macronutrients, stays emulsified, and has long shelf life or freezer life.<sup>1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



# FOOD <sup>AS</sup> 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



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

# **U.S. Government's Top 10 “Greatest Hits” Still in Place Today**

1. 1790 — Sugar tariff
2. 1933 — Dust Bowl, Farm Bill, first food subsidies
3. 1959 — Fall of Bautista and rise of Castro in Cuba, altered sugar imports, Fanjul Bros.
4. 1971 — Richard Nixon and USDA Secretary Earl Butz, make food cheap, monoculture
5. 1977 — McGovern Commission, first Dietary Guidelines for Americans, fat is the enemy
6. 1980 — Hurricane Allen destroyed Caribbean sugar crop, HFCS given green light
7. 1986 — FDA reviews data on sugar, results “inconclusive”
8. 1990 — Nutrition Labeling and Education Act (NLEA), Nutrition Facts
9. 1994 — Dietary Supplement Health and Education Act (DSHEA), nutraceuticals
10. 1997 — Food Safety Modernization Act, Generally Recognized as Safe (GRAS) Loophole

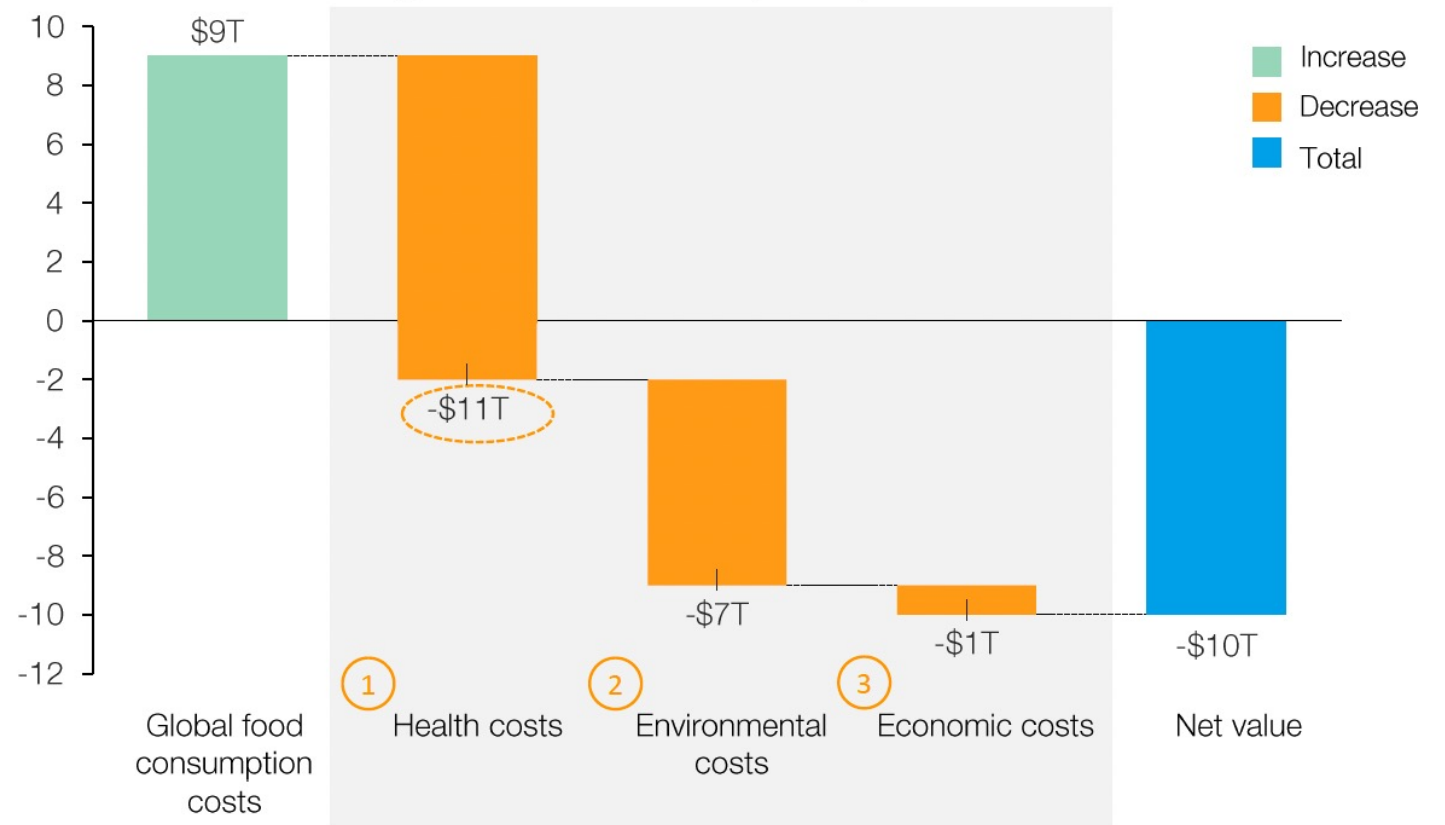
# Prospects for the true cost accounting of food systems

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)





# **The goal: Metabolic Health**

## **The Strategies:**

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

## What is the definition of “healthy”?

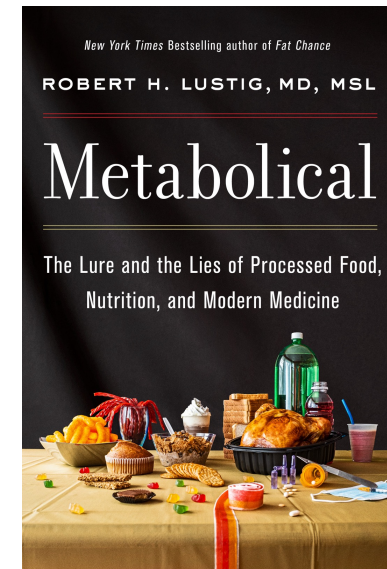
- Michael Pollan said, “Eat Food. Not Too Much. Mostly Plants.”
- *Eat food*: Some need a low-fat diet, others need a high-fat diet.
- *Not too much*: Doesn't take into account mitochondrial dysfunction.
- *Mostly plants*: Coke, Doritos, and Oreos are plant-based.

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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.

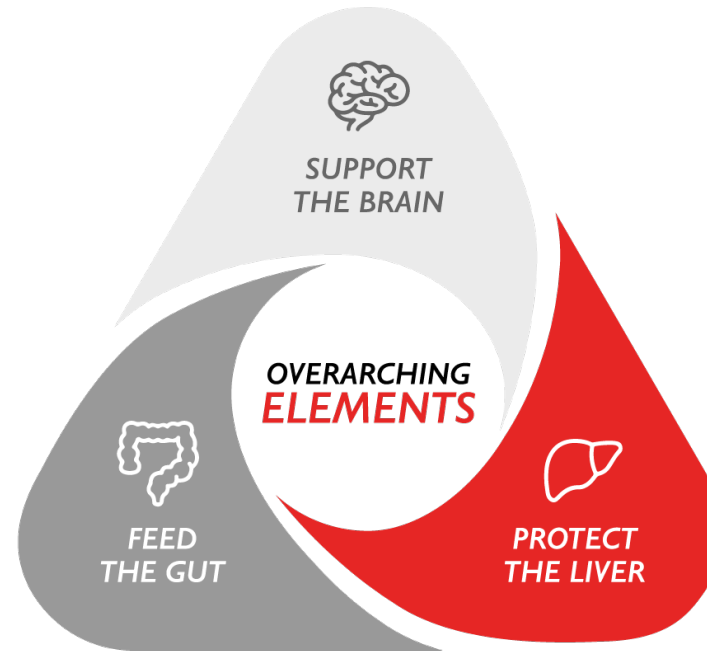
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- 
- I suggest a different three principles:





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



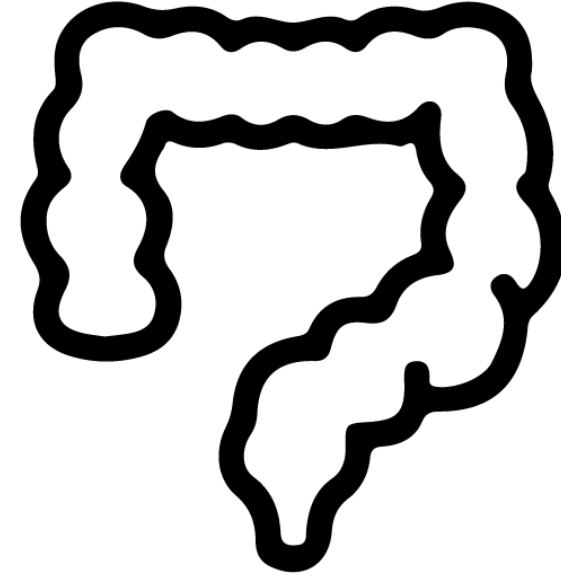
Unprocessed food feeds the gut  
Ultraprocessed food causes “leaky gut”  
Short chain fatty acids  
Fiber contributes to microbiome health

Fructose reduction  
Reduce glycemic load  
Appropriate hydration  
Reduce environmental toxins

## The Metabolic Matrix

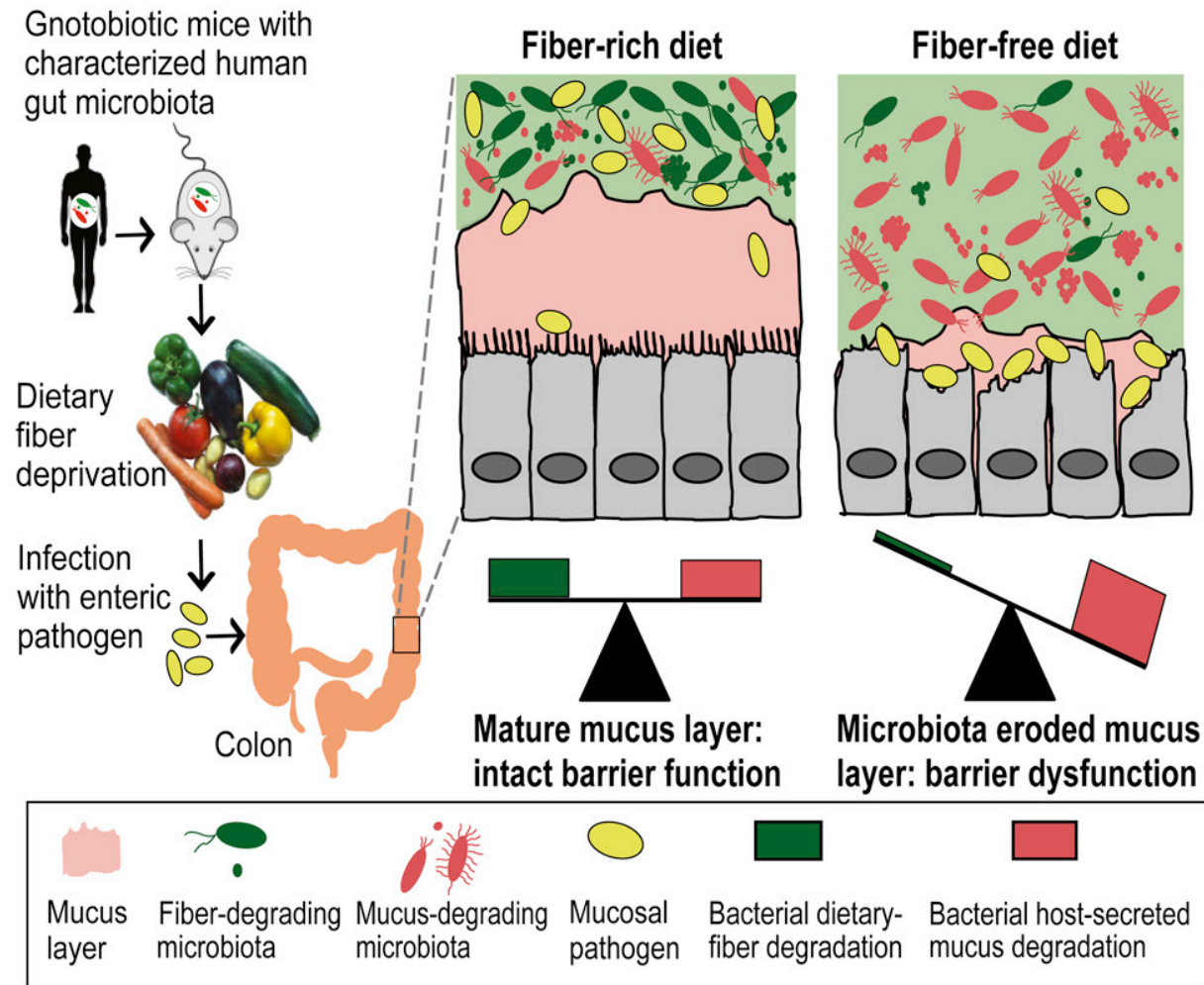
# The Metabolic Matrix: Gut Health

- 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

Colonic bacteria make short chain fatty acids

## Insoluble Fiber alone:

Induces the satiety signal sooner

Removes cancer cells from colon

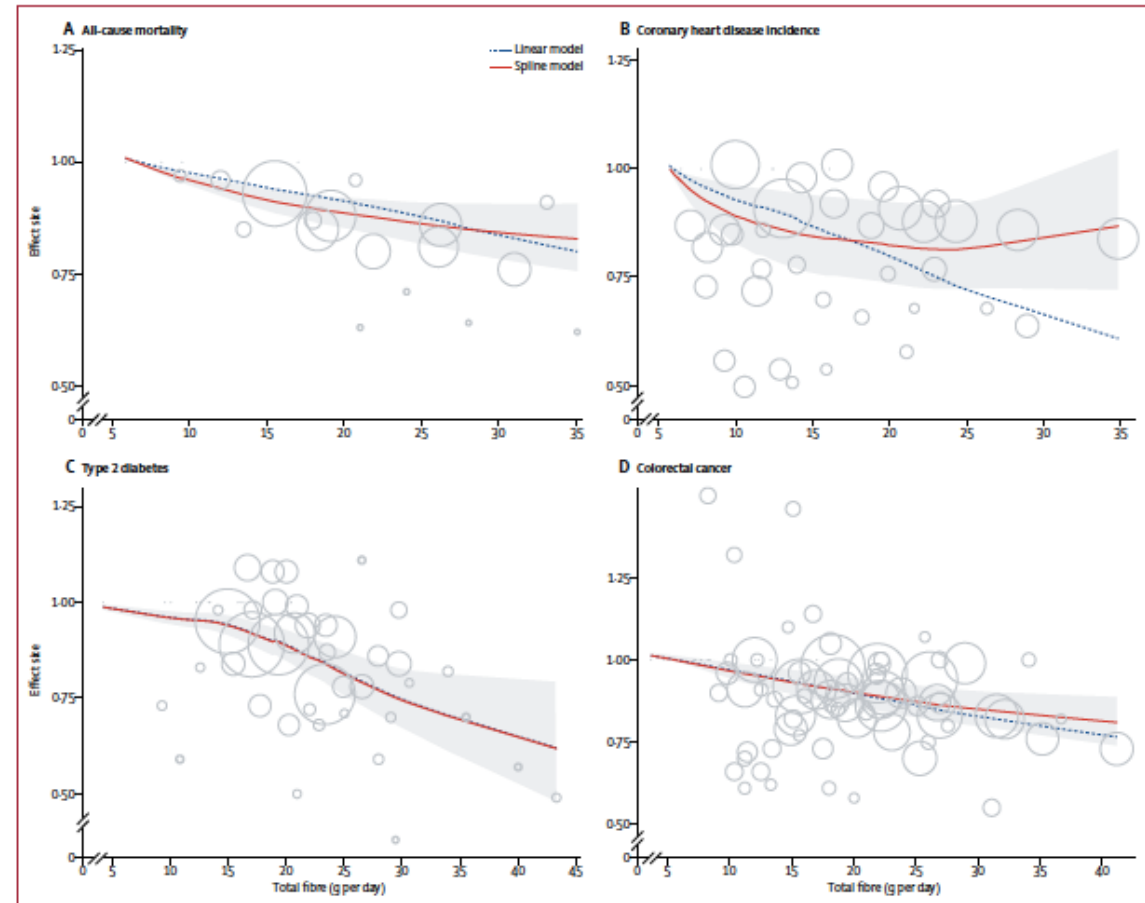
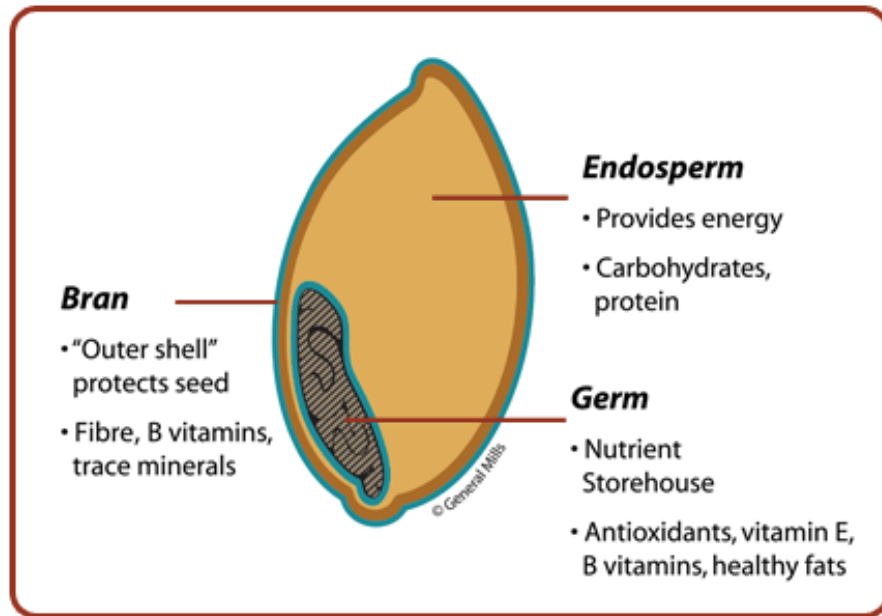


Figure 1: Dose-response relationships between total dietary fibre and critical clinical outcomes based on data from prospective studies  
(A) Total fibre and all-cause mortality. 68183 deaths over 11.3 million person-years. Assuming linearity a risk ratio of 0.93 (95% CI 0.90-0.95) was observed for every 8 g more fibre consumed per day.  
(B) Total fibre and incidence of coronary heart disease. 6449 deaths over 2.5 million person-years. Assuming linearity a risk ratio of 0.81 (0.73-0.90) was observed for every 8 g more fibre consumed per day.  
(C) Total fibre and incidence of type 2 diabetes. 22450 cases over 3.2 million person-years. Assuming linearity a risk ratio of 0.85 (0.82-0.89) was observed for every 8 g more fibre consumed per day.  
(D) Total fibre and incidence of colorectal cancer. 20009 cases over 20.9 million person-years. Assuming linearity a risk ratio of 0.92 (0.89-0.95) was observed for every 8 g more fibre consumed per day.



# The Metabolic Matrix: Feed the Gut

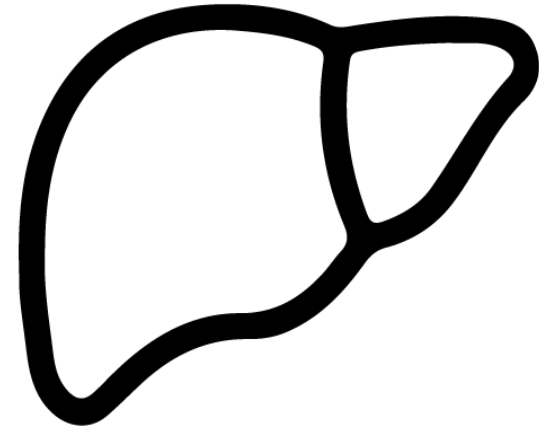


## Fiber is critical

- 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%

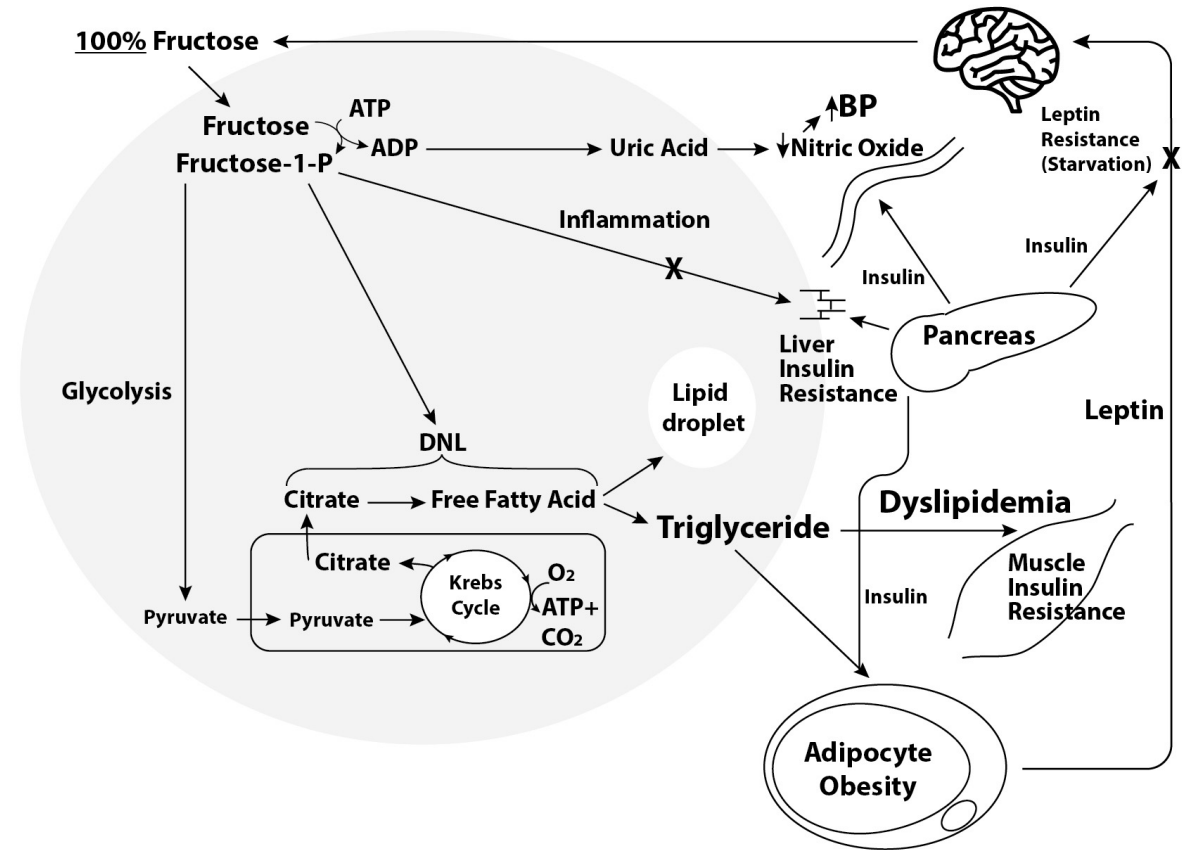
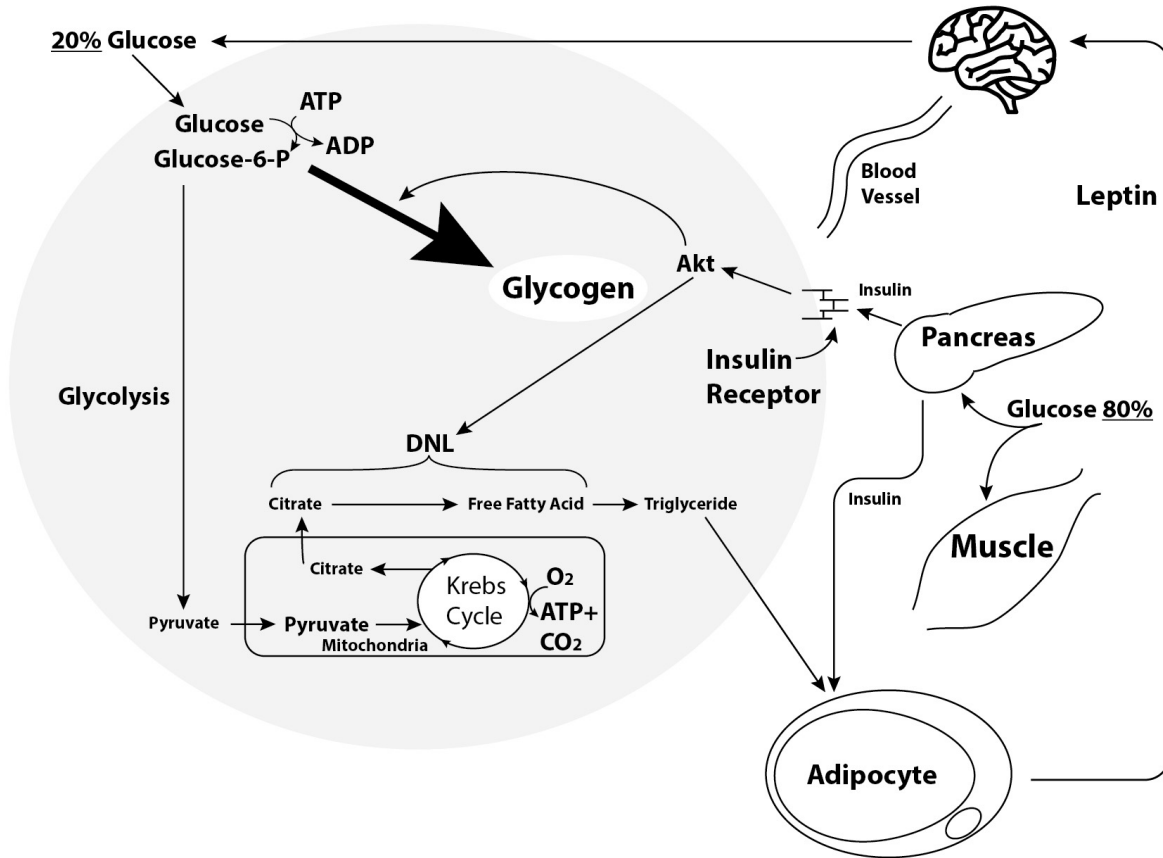


Fat, Metabolically Ill  
High Liver Fat = 24%

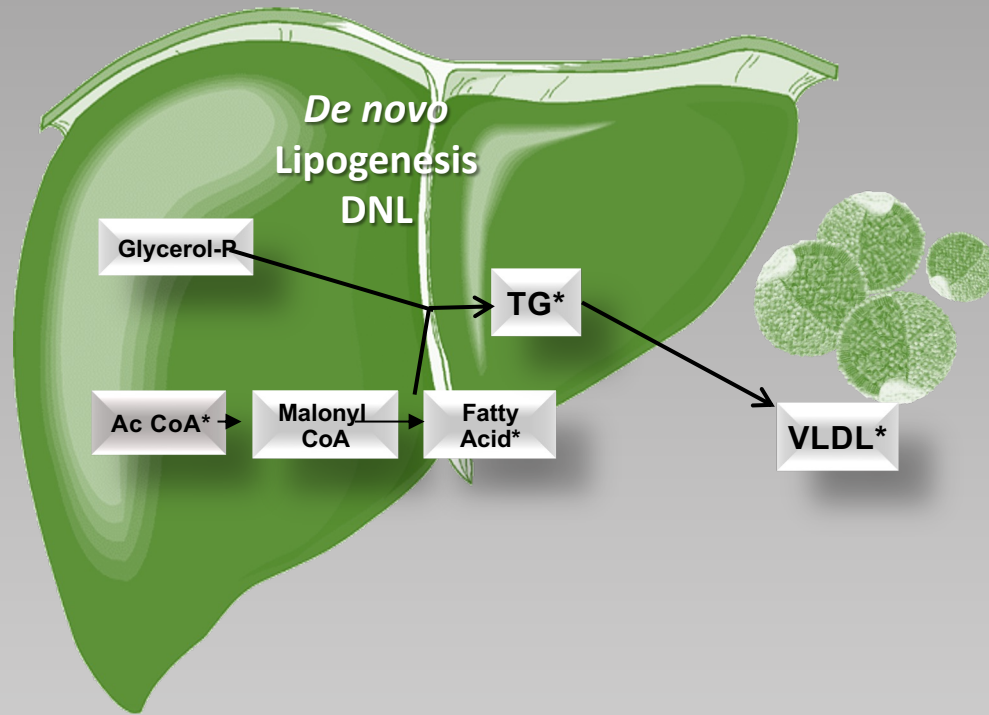


Thin, Metabolically Ill  
High Liver Fat = 23%

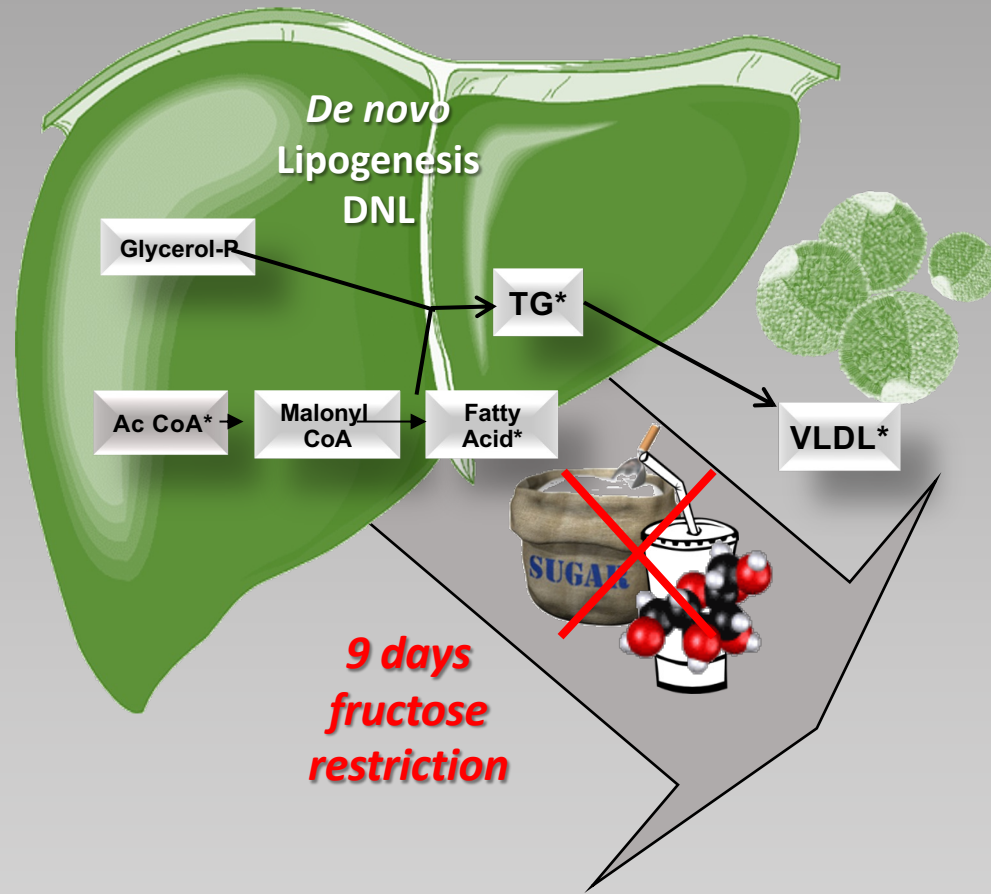
# Fructose is metabolized in the liver differently than glucose



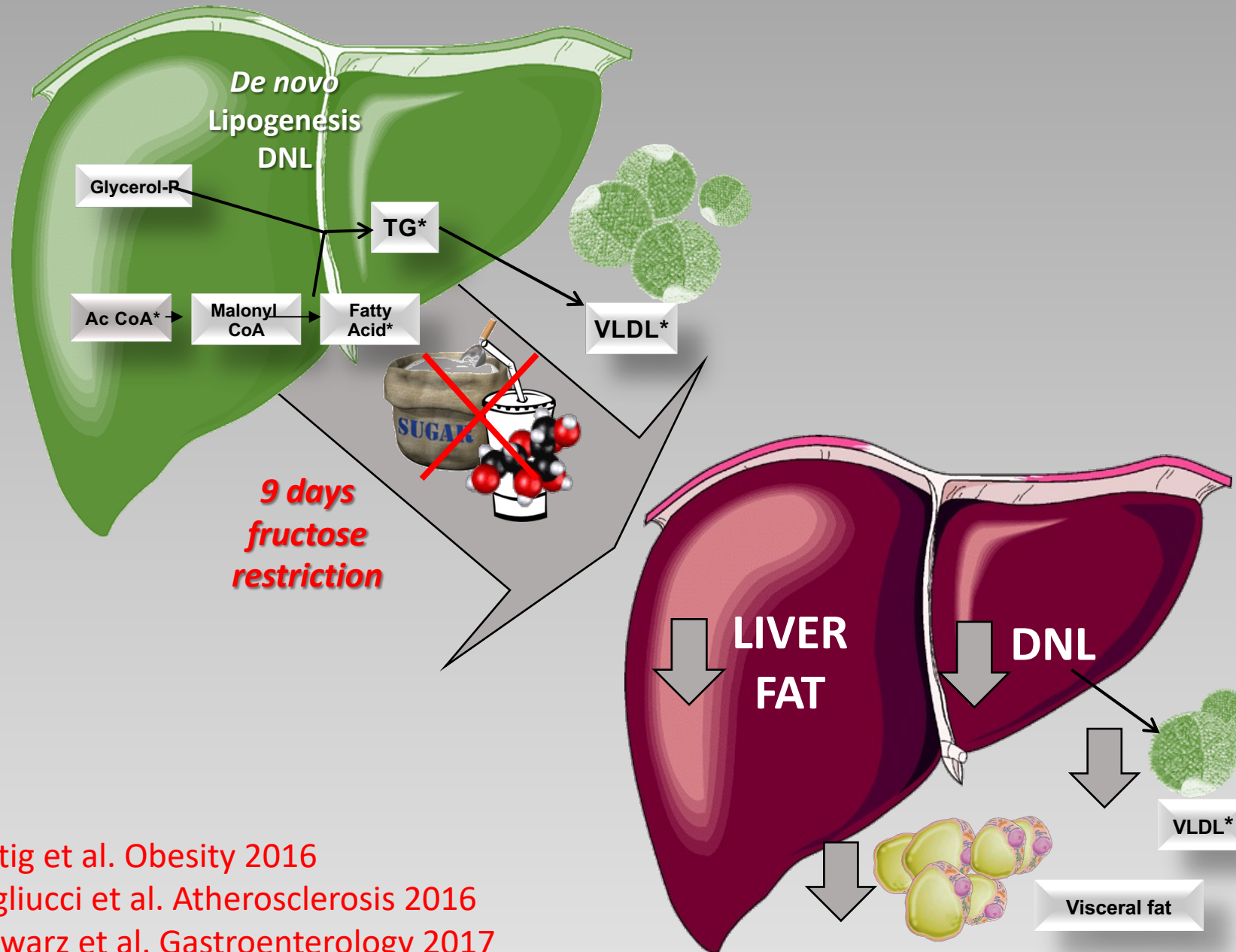




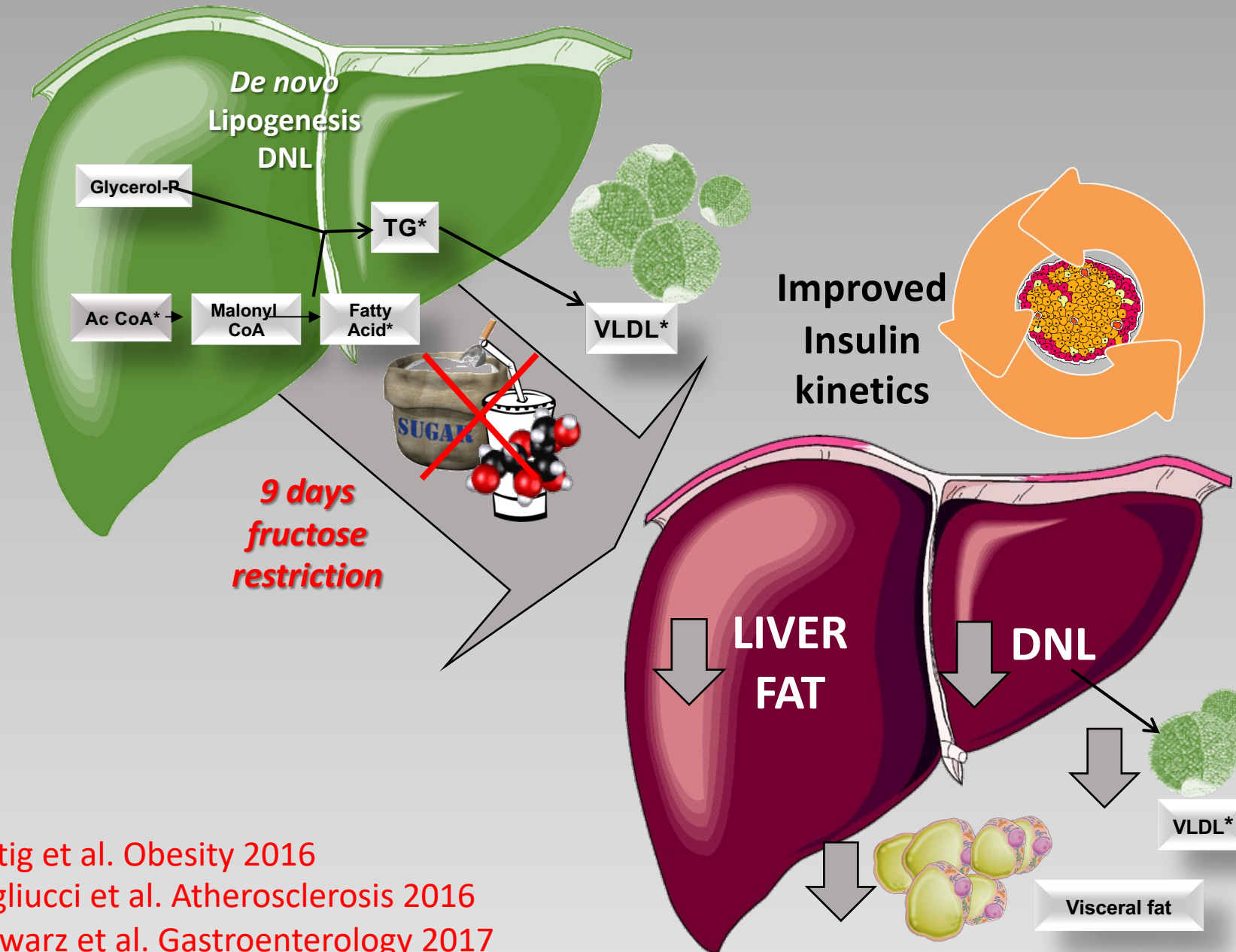
Lustig et al. Obesity 2016  
Gugliucci et al. Atherosclerosis 2016  
Schwarz et al. Gastroenterology 2017  
Olson et al. Nutrients 2022



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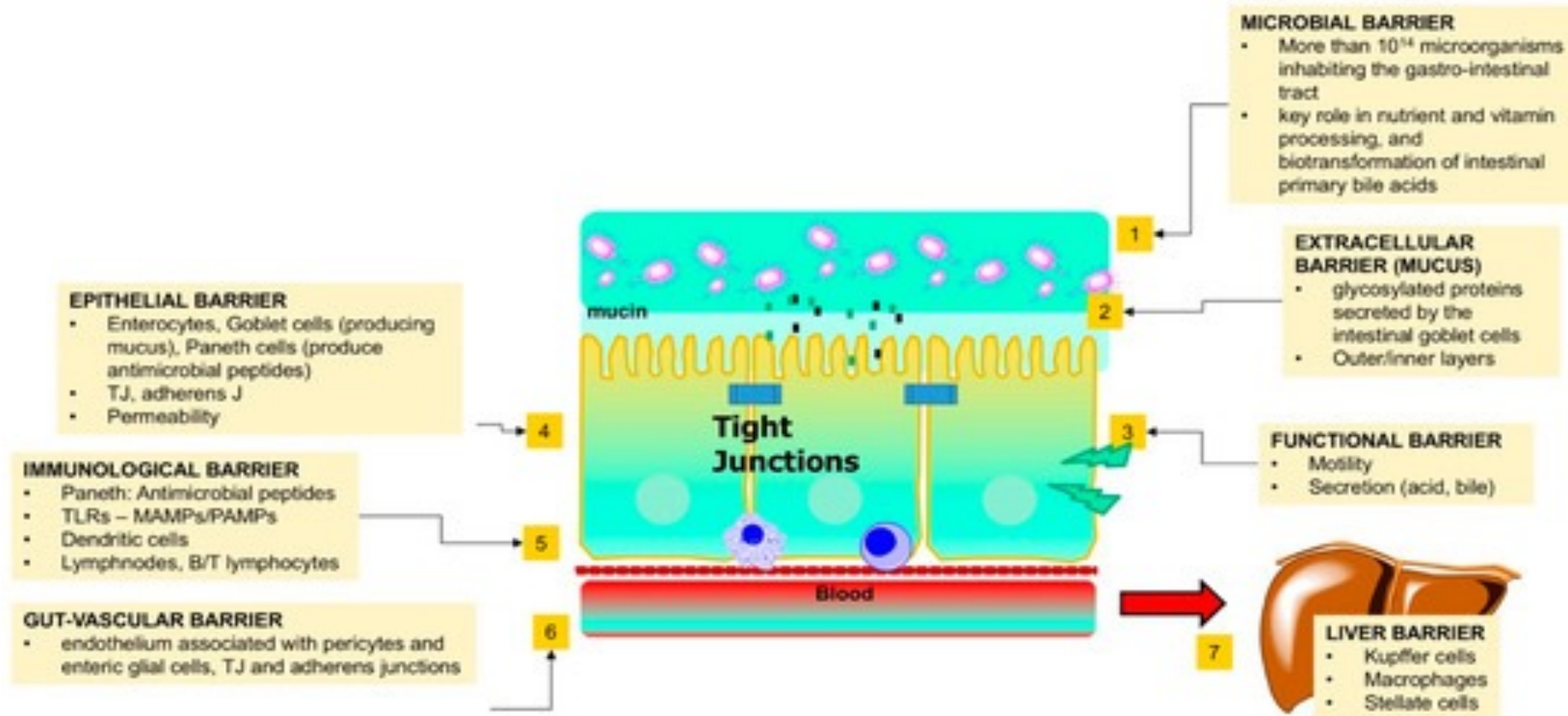
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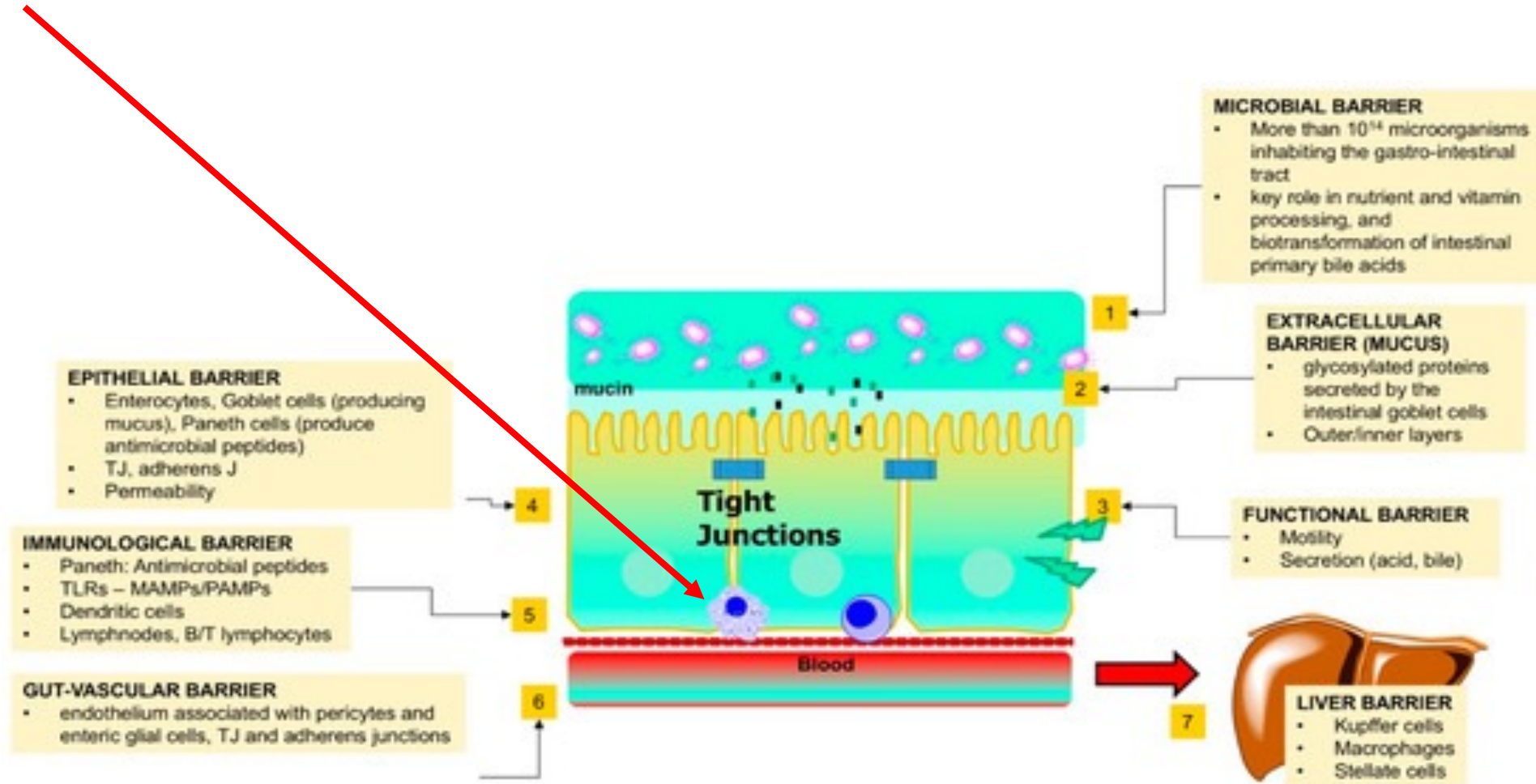


# Tight junctions keep bad stuff out

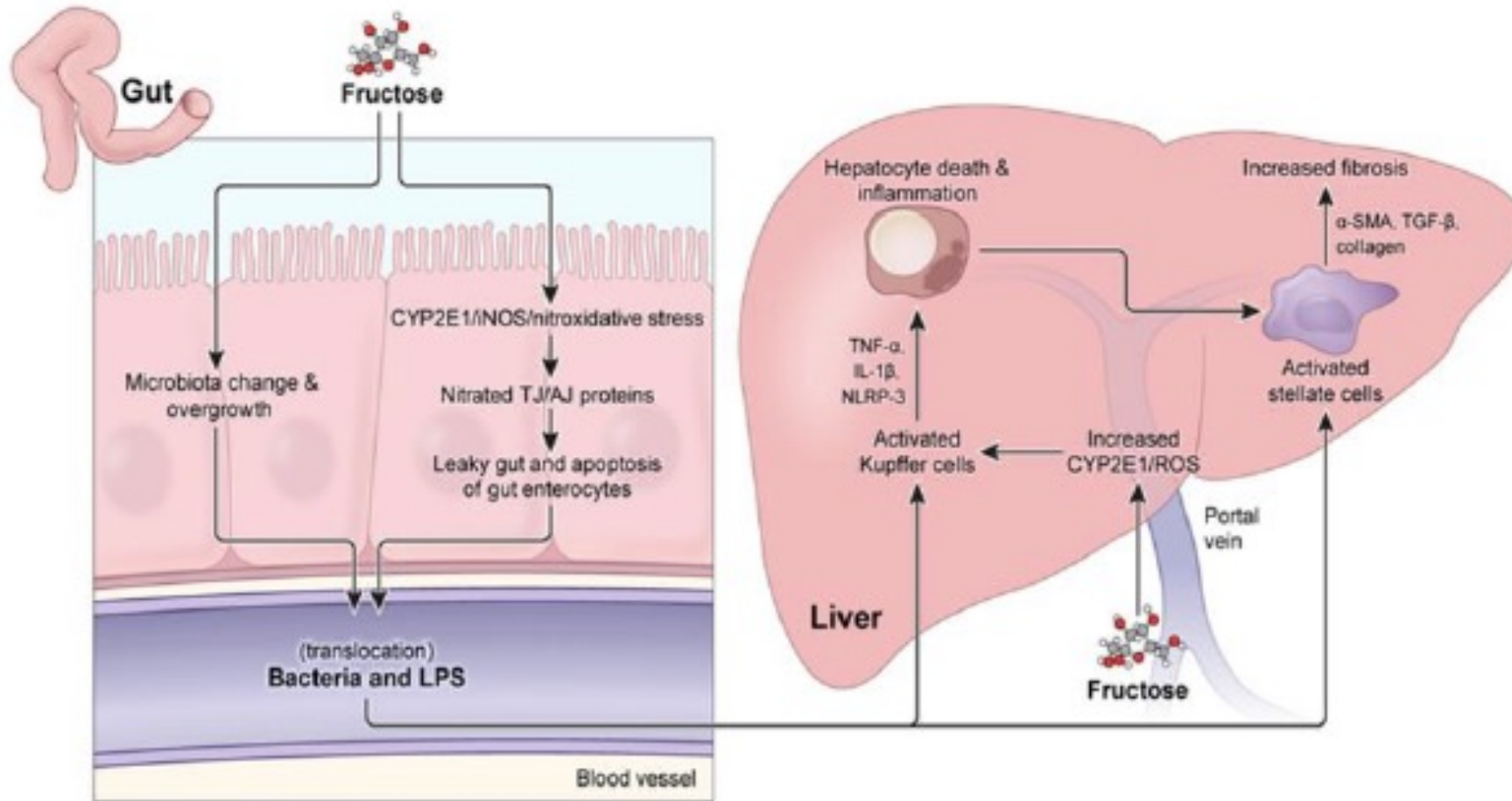


# Tight junctions keep bad stuff out

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

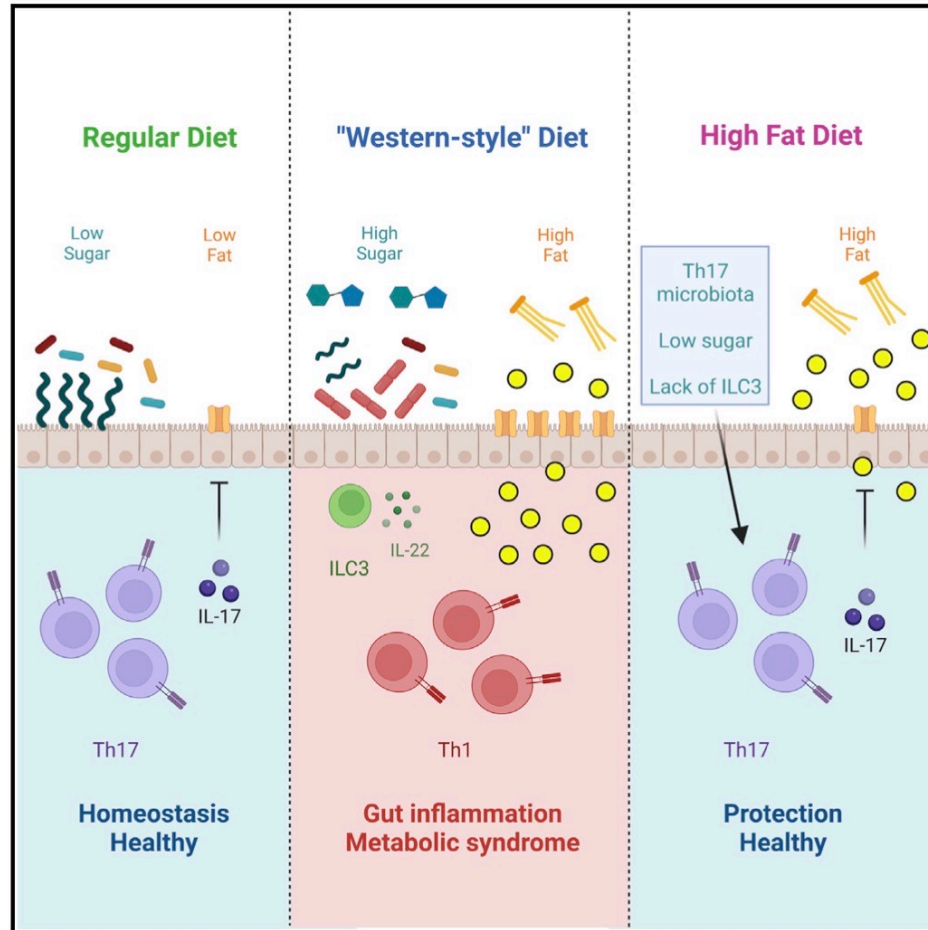


# Fructose also disrupts tight junctions, and lets bad stuff in



# Sugar alters Th17 barrier in the intestine

## Graphical abstract











*nutrients*



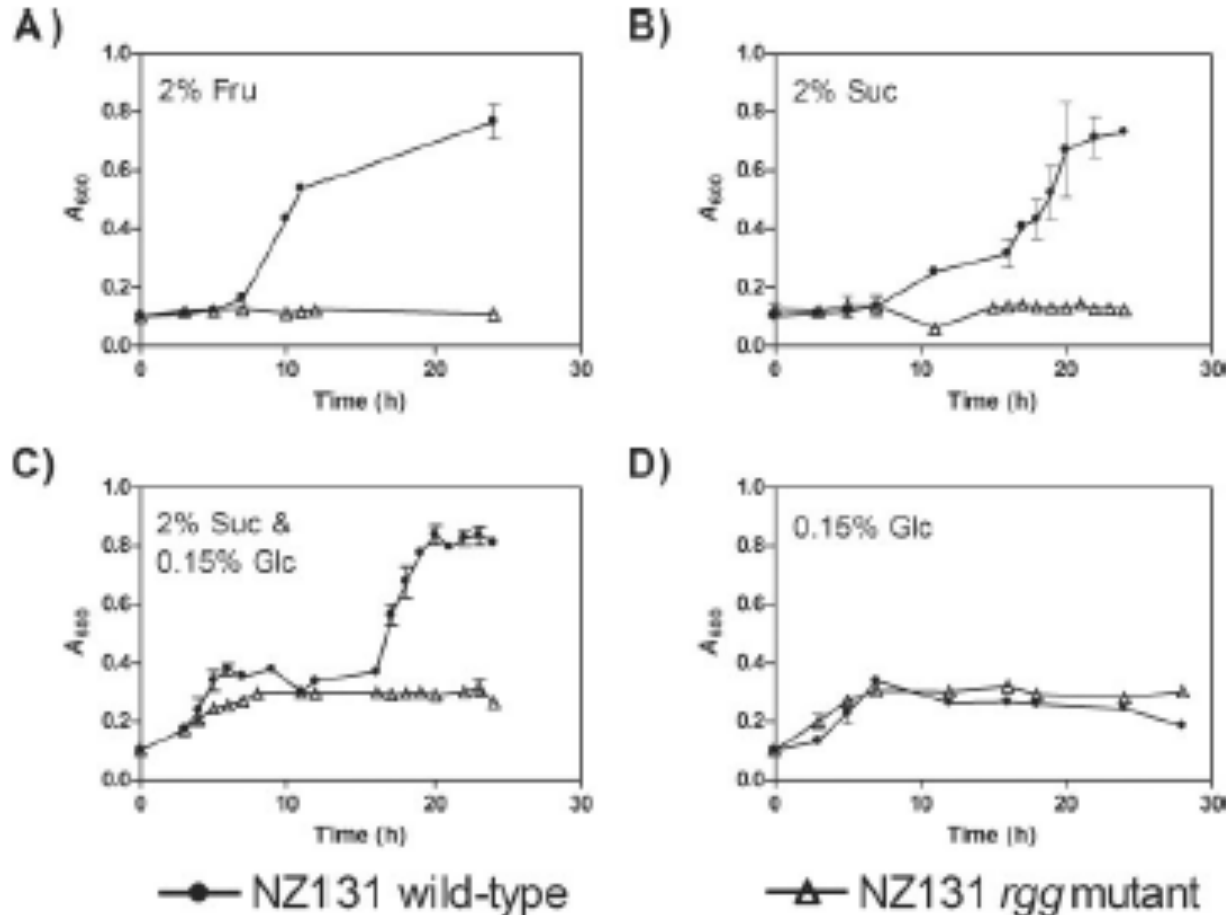
*Article*

# 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> 

- . Higher consumption of free sugars in active vs. inactive SLE  
(8.60%  $\pm$  5.51 vs, 6.36%  $\pm$  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

# Fructose and Cancer/Dementia



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>

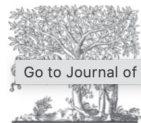
<sup>1</sup>Monash Institute of Pharmaceutical Sciences, Monash University, Parkville, VIC, Australia

<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>

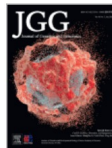
Febbraio et al. Cell Metab 33:2316, 2021



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. Lanaspa<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**

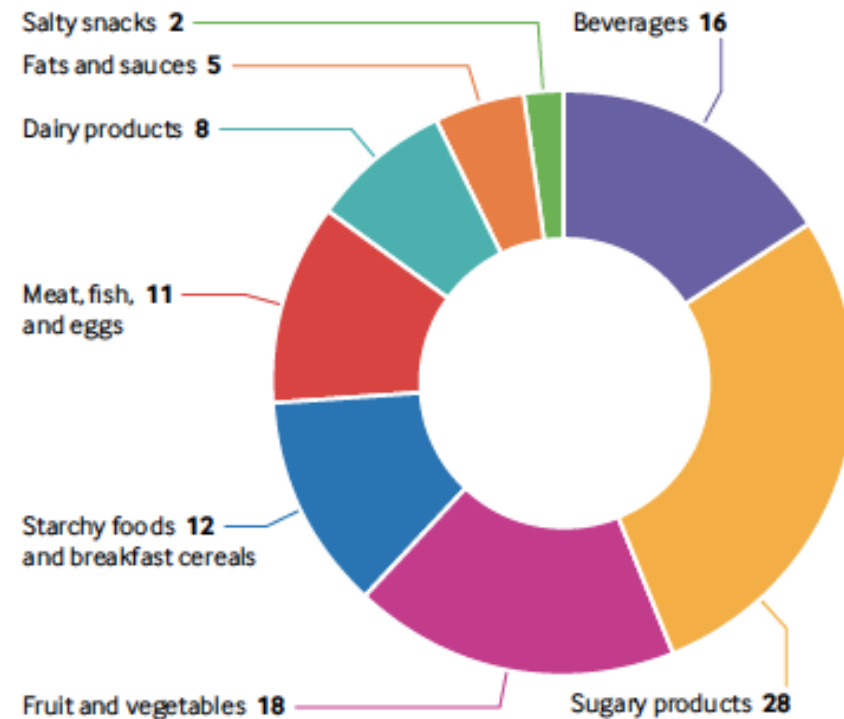
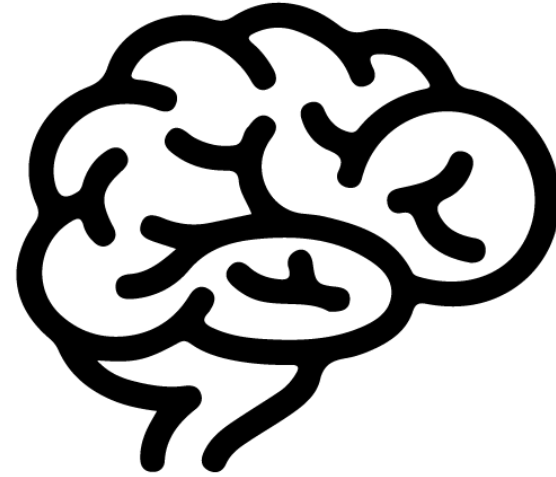


Fig 2 | Relative contribution (%) of each food group to consumption of ultra-processed food in diet



# 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***

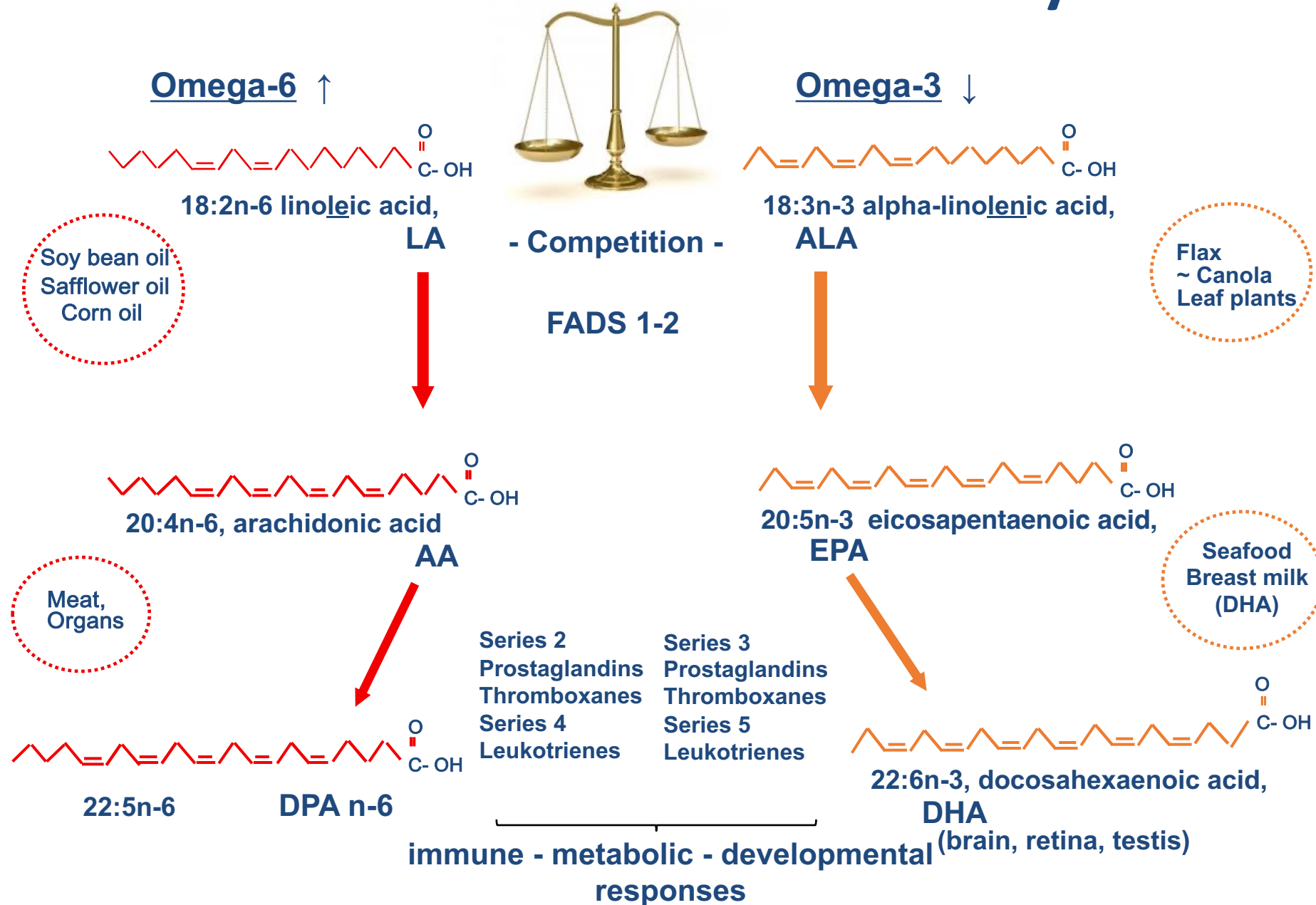
A close-up photograph of a person's hand holding a glowing, wireframe model of a human brain. The brain is rendered in a translucent, yellowish-white wireframe style, with internal structures visible. It is held gently in the palm of a hand, with the fingers supporting it from below. The background is a textured, grey surface. The overall lighting is soft and focused on the brain, giving it a sense of importance and mystery.

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



Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA)

Volume 110, July 2016, Pages 42–47



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

Natalie Parletta<sup>a</sup>, Dorota Zarnowiecki<sup>a</sup>, Jihyun Cho<sup>a</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





Brain-selective nutrients





# **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**

# 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.



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

## 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



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).





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

# **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)**