

Reducing added sugars: *Will it reverse the trend toward overweight & obesity?*

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Chicago, 23 October 2018



Disclosure statement

24-year industry consultant with 37 years of experience in nutritive (caloric) sweeteners.

Past and present consulting relationships include individual companies, trade organizations and research institutes related to the manufacture and use of nutritive sweeteners.

Clients have an on-going interest in nutritive sweetener research, development, production, applications, safety and nutrition.

What are added sugars?

Added sugars

*Caloric sweeteners added to foods as ingredients
during processing or at the table*

Glucose only sugars

- ◆ Dextrose (glucose)
- ◆ Corn syrups
(glucose polymers)

Glucose+Fructose sugars

- ◆ Sucrose (common table sugar)
Liquid sugar
Invert sugar
- ◆ High fructose corn syrup
(HFCS, HFS, SBS, isoglucose)
- ◆ Honey/syrups
- ◆ Fruit juice concentrates
- ◆ Agave nectar

Why add sugars...?

Sweetness and functionality

- ◆ Monosaccharides – *especially fructose and HFCS*
 - Liquid handling
 - Hygroscopicity – attracts/absorbs moisture
 - Humectancy – binds/retains moisture
 - Colligative properties – freezing point; osmotic control (microbes)
 - Reducing sugars – Maillard browning; color stability
 - Sweetness/profile – Sweetening/flavor enhancement
 - Sugars stability in acidic foods/beverages
 - Fermentability
- ◆ Disaccharides – *especially sucrose*
 - Crystallize well
 - Many of the properties above; relative effects

**Why the current focus on
added sugars?**

Sugars have been a focus of attention for decades



HIGH FRUCTOSE CORN SYRUP



SWEET
POISON

COMMENT

WORLD Komodo dragons and
rhinos could reduce fire
in Australia **p.30**

NEUROSCIENCE The source of the
self is in the brain's wiring,
not individual neurons **p.31**

LITERATURE How Charles
Dickens drew on science, but
left room for wonder **p.32**

HOW TO LIVE Philip Lawley and the
discovery that DNA damage
can cause cancer **p.36**



The toxic truth about sugar

Added sweeteners pose dangers to health that justify controlling them like alcohol, argue Robert H. Lustig, Laura A. Schmidt and Claire D. Brindis.

Last September, the United Nations declared that, for the first time in human history, chronic non-communicable diseases such as heart disease, cancer and diabetes pose a greater health burden worldwide than do infectious diseases, contributing to 35 million deaths annually. This is not just a problem of the developed world. Every country that has adopted the Western diet — one dominated by low-cost, highly processed food — has witnessed rising rates of obesity and related diseases. There are now 30% more people who are obese than who are undernourished. Economic development means that the populations of low- and middle-income countries are living longer, and therefore are more

SUMMARY

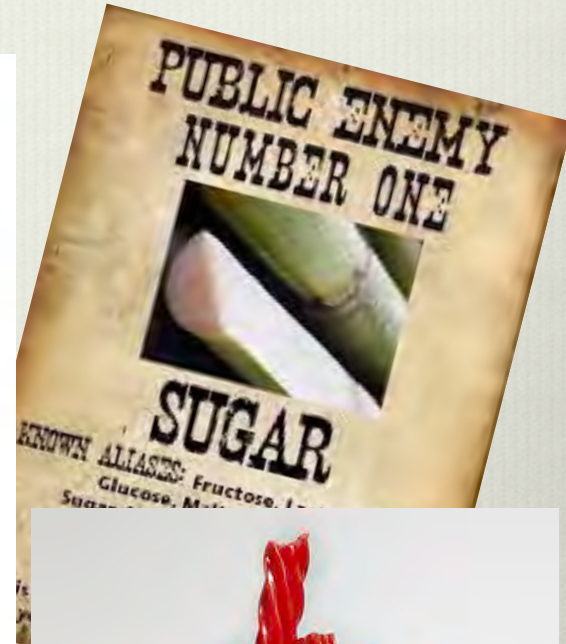
- Sugar consumption is linked to a rise in non-communicable disease
- Sugar's effects on the body can be similar to those of alcohol
- Regulation could include tax, limiting sales during school hours, and placing age limits on purchasing

susceptible to non-communicable diseases; 80% of deaths attributable to them occur in these countries.

Many people think that obesity is the root cause of these diseases. But 20% of obese people have normal metabolism and

will have a normal lifespan. Conversely, up to 40% of normal-weight people manifest the diseases that constitute the metabolic syndrome: diabetes, hypertension, lipid problems, cardiovascular disease, non-alcoholic fatty liver disease, cancer and dementia. Obesity is not the cause; rather, it is a marker for metabolic dysfunction, which is even more prevalent.

The UN announcement targets tobacco, alcohol and diet as the central risk factors in non-communicable disease. Two of these three — tobacco and alcohol — are regulated by governments to protect public health, leaving one of the primary culprits behind this worldwide health crisis unchecked. Of course, regulating food is more



Some hold sugars *uniquely* responsible

Toxic Effects of Sugar

Premature aging process

Suppresses immunity

Disturbs mineral balance

Raises cholesterol &
triglycerides

Increased risk of
Alzheimer's

Diabetes & hyperglycemia

Tooth decay & disease

Weight gain & obesity

Candida overgrowth

Kidney disease

Hyperactivity

Depression & anxiety

Various cancers

Weakened eyesight

Osteoporosis

Coronary heart disease

Crohn's disease &
ulcerative colitis

Asthma

Arthritis

Gallstones & kidney stones

Hormonal imbalances

Appendicitis

Exacerbation of MS

Decreased growth
hormones

Emphysema

Atherosclerosis

Fatty liver

Constipation

Fluid retention

Headaches & Migraines

Top five diet-related chronic diseases

Dietary Guidelines for Americans, 2010

Cardiovascular Disease

81.1 million Americans — **37% of the population.**

Hypertension

74.5 million Americans — **34% of U.S. adults.**

Diabetes

Nearly 24 million people age 20+ — **almost 11% of the population.**

Cancer

Almost one in two men and women— **about 41% of the population.**

Osteoporosis

50% of women and 25% of men ages 50 years and older

Rationale for the *Added Sugars Hypothesis*

1. Significant diseases related to intermediary metabolism are increasing around the world.
2. Added sugars contribute calories but no essential nutrients.
3. Added sugars are ***increasing*** in the human diet.
4. HFCS is ***unique*** compared with sucrose and other sweeteners.
5. Fructose is a ***good proxy*** for added sugars.
6. High value, cause-and-effect evidence ***uniquely*** links added sugars metabolism to these diseases in humans at typical exposure levels and patterns.
7. Reducing added sugars will ***reverse*** overweight and obesity

Evolving views on added sugars

◆ Regulatory recommendations

- $\leq 25\%$ of energy (≈ 500 kcal/day)
*Institute of Medicine Carbohydrate Report (2002);
Dietary Guidelines for Americans 2010*
- $< 10\%$ of energy (Men ≤ 150 kcal/day; Women ≤ 100 kcal/day)
American Heart Association
- $\leq 5\text{-}10\%$ of energy (≈ 200 kcal/day)
World Health Organization; Scientific Advisory Committee on Nutrition (UK)
- $\leq 10\%$ of energy (≈ 200 kcal/day)
Dietary Guidelines for Americans 2015

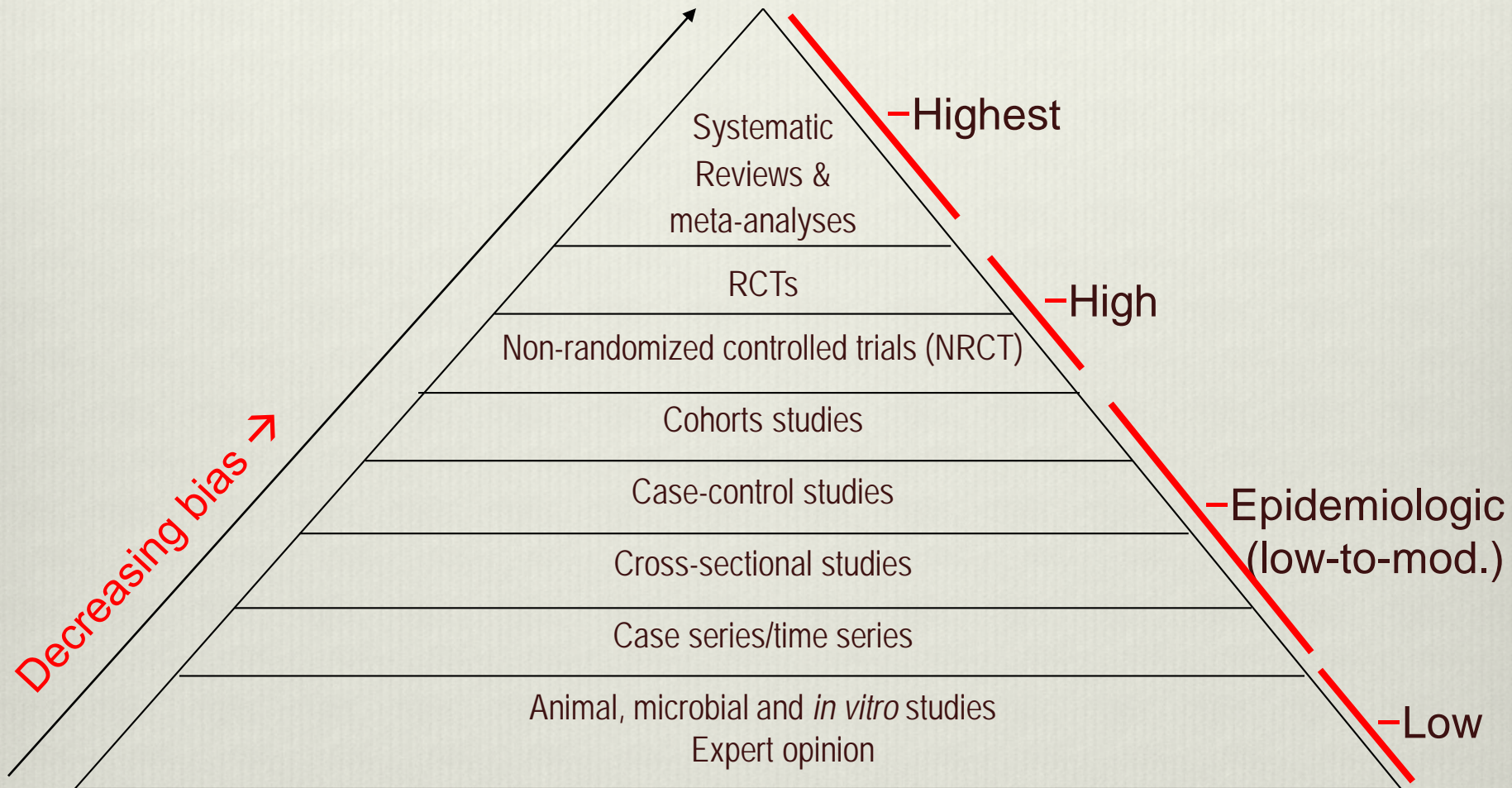
◆ Legislative activity

- Taxes on sugar-sweetened beverages
- Proposed bans/limits *uniquely* on HFCS (Turkey; FL School Lunch Program)

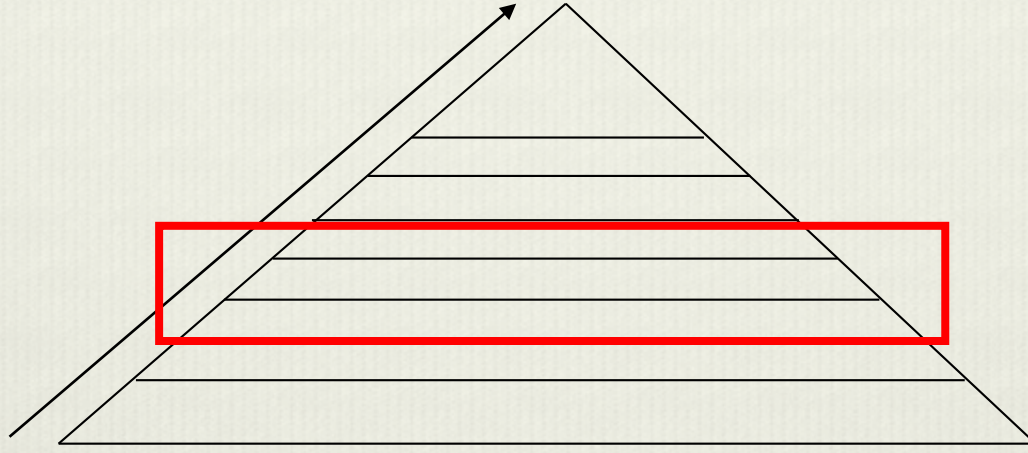
Supporting evidence is of low value

Scientific evidence is not
all created equal...
the Evidence Pyramid

Value hierarchy in evidence-based medicine



Are added sugars *increasing*
in the human diet?

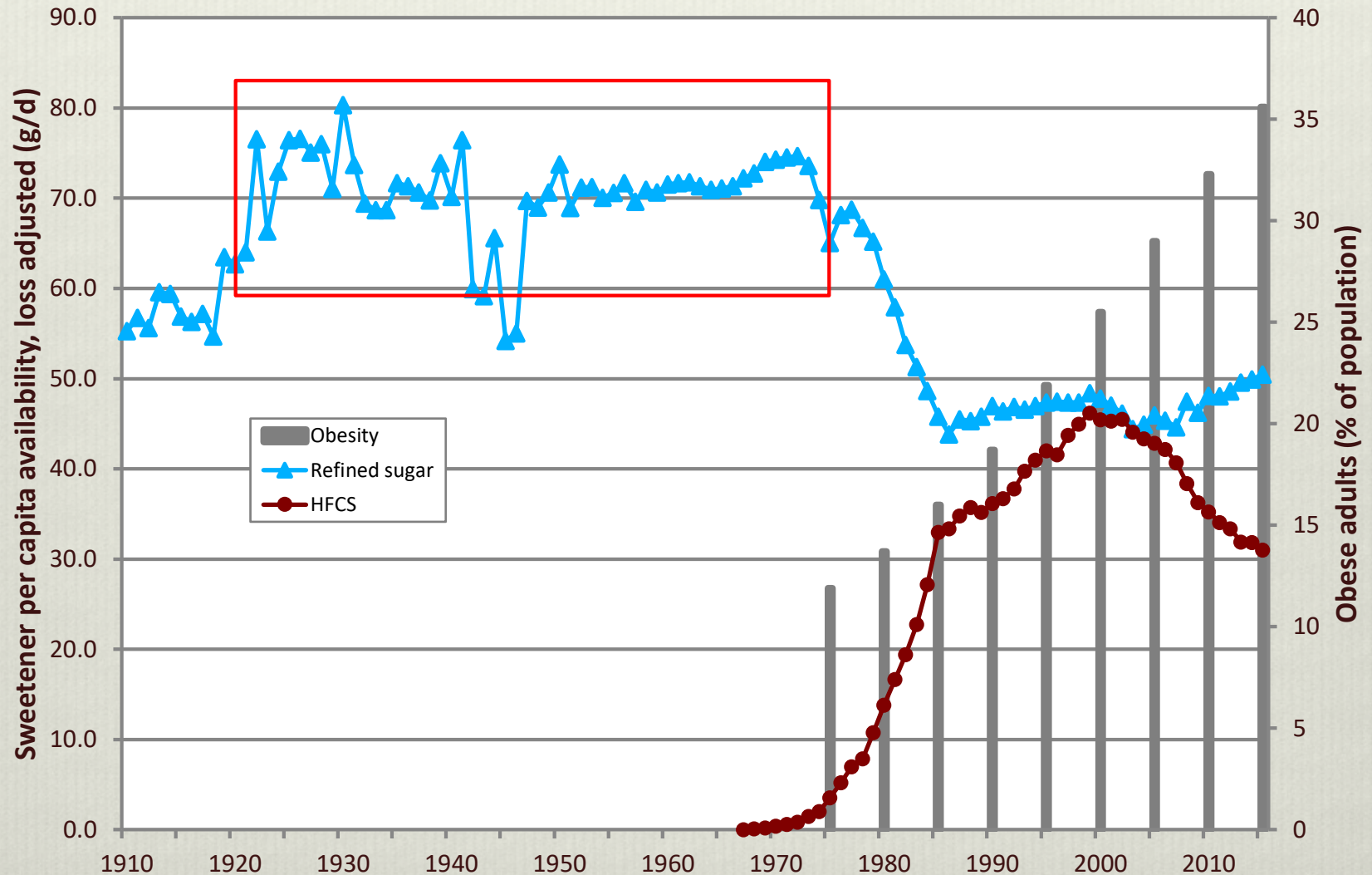


Epidemiologic data

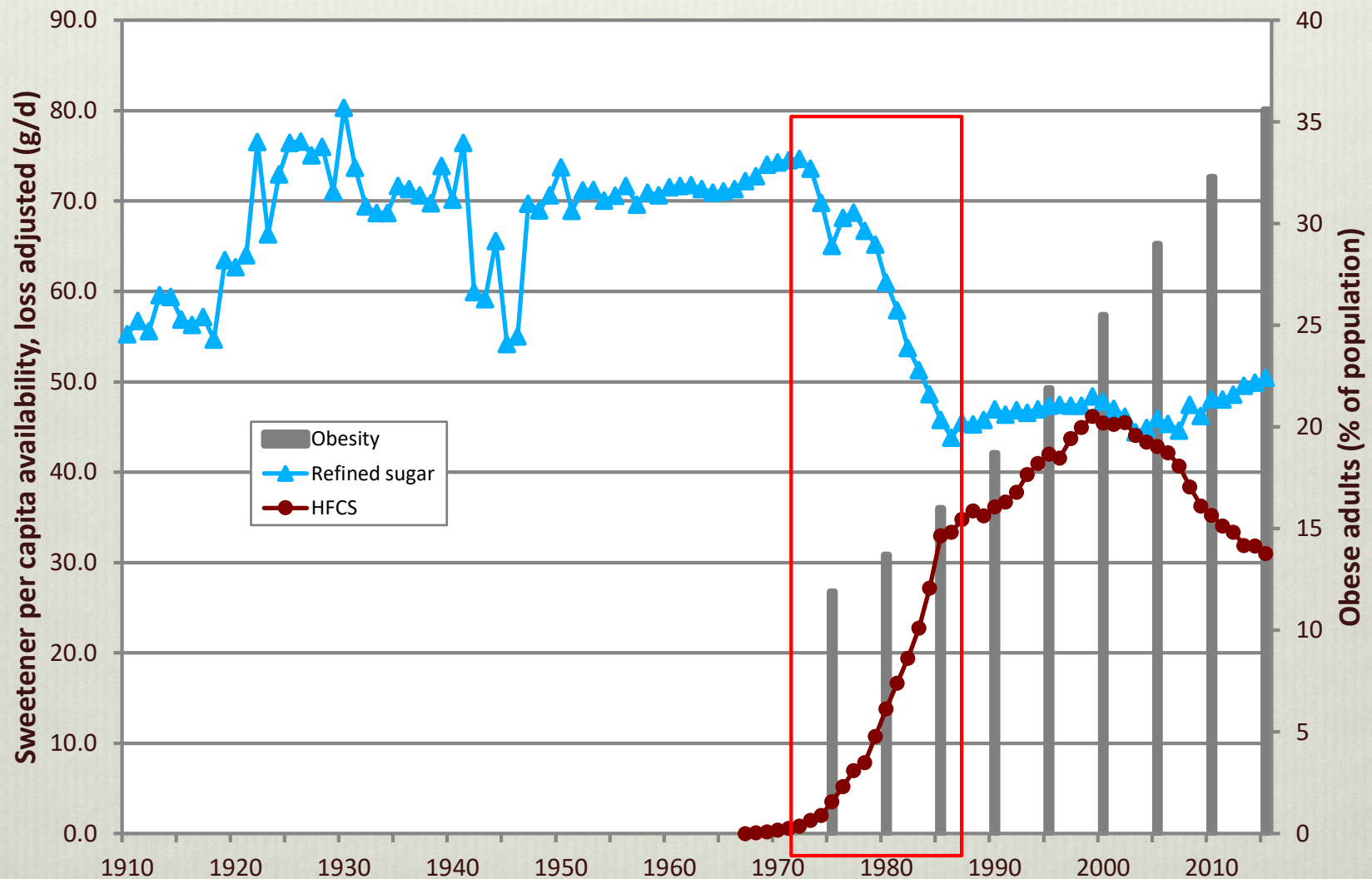
[low-to-moderate evidentiary value;
correlations of disease with large populations]

Do added sugars correlate with obesity?

Sugar availability was remarkably constant in the U.S., 1920-1975

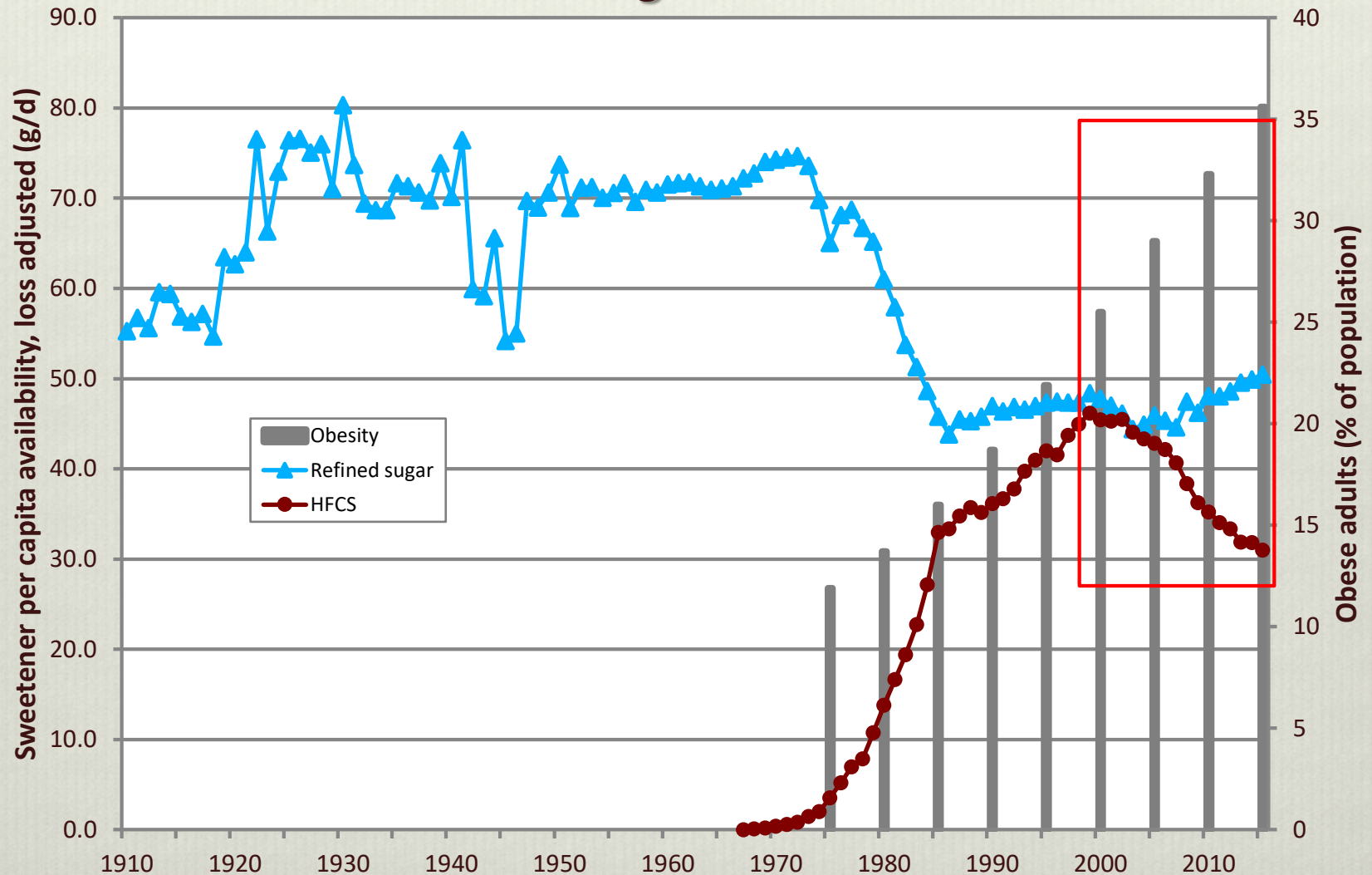


HFCS displaced sugar 1:1, 1972-1986

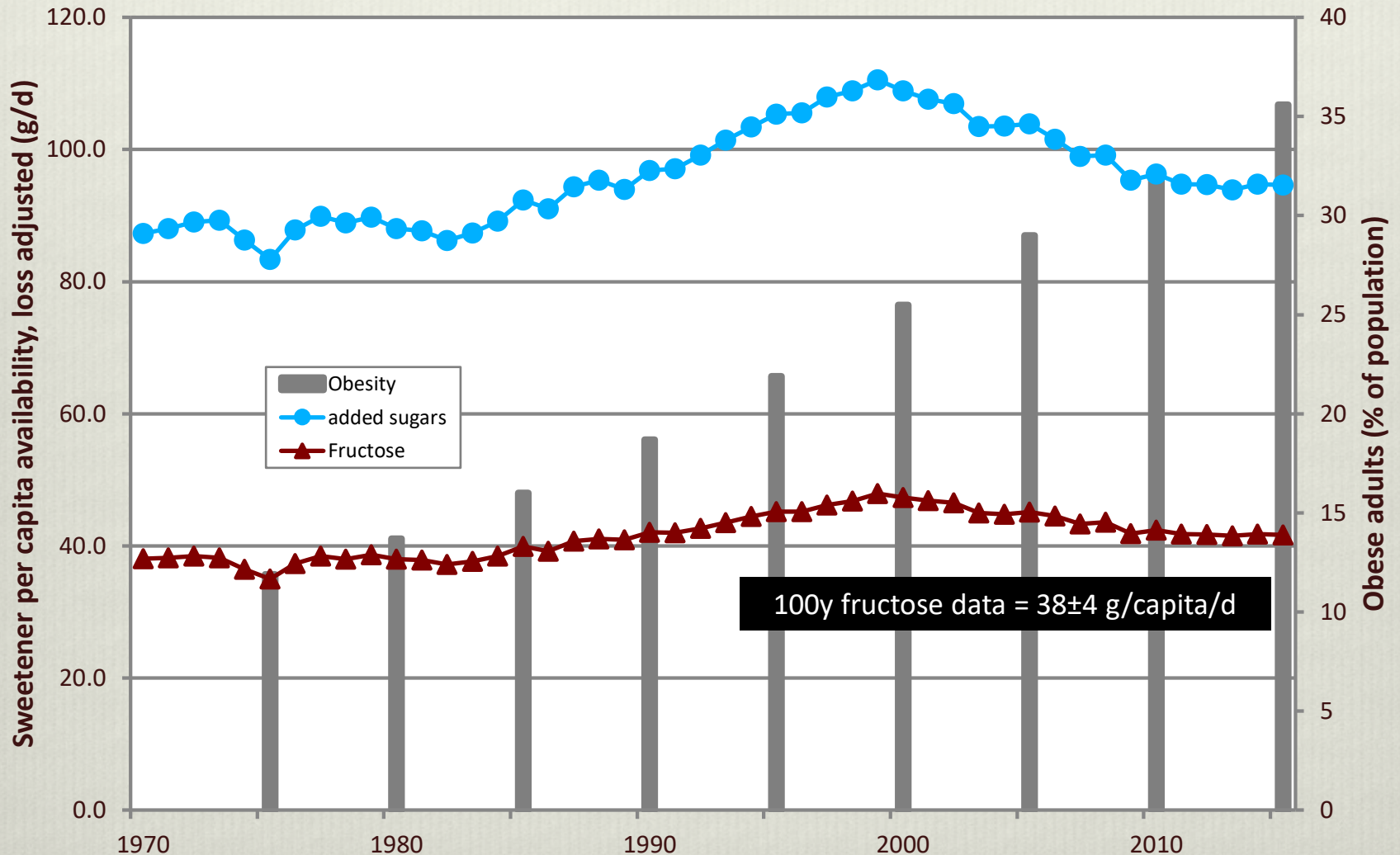


HFCS in 19y decline...

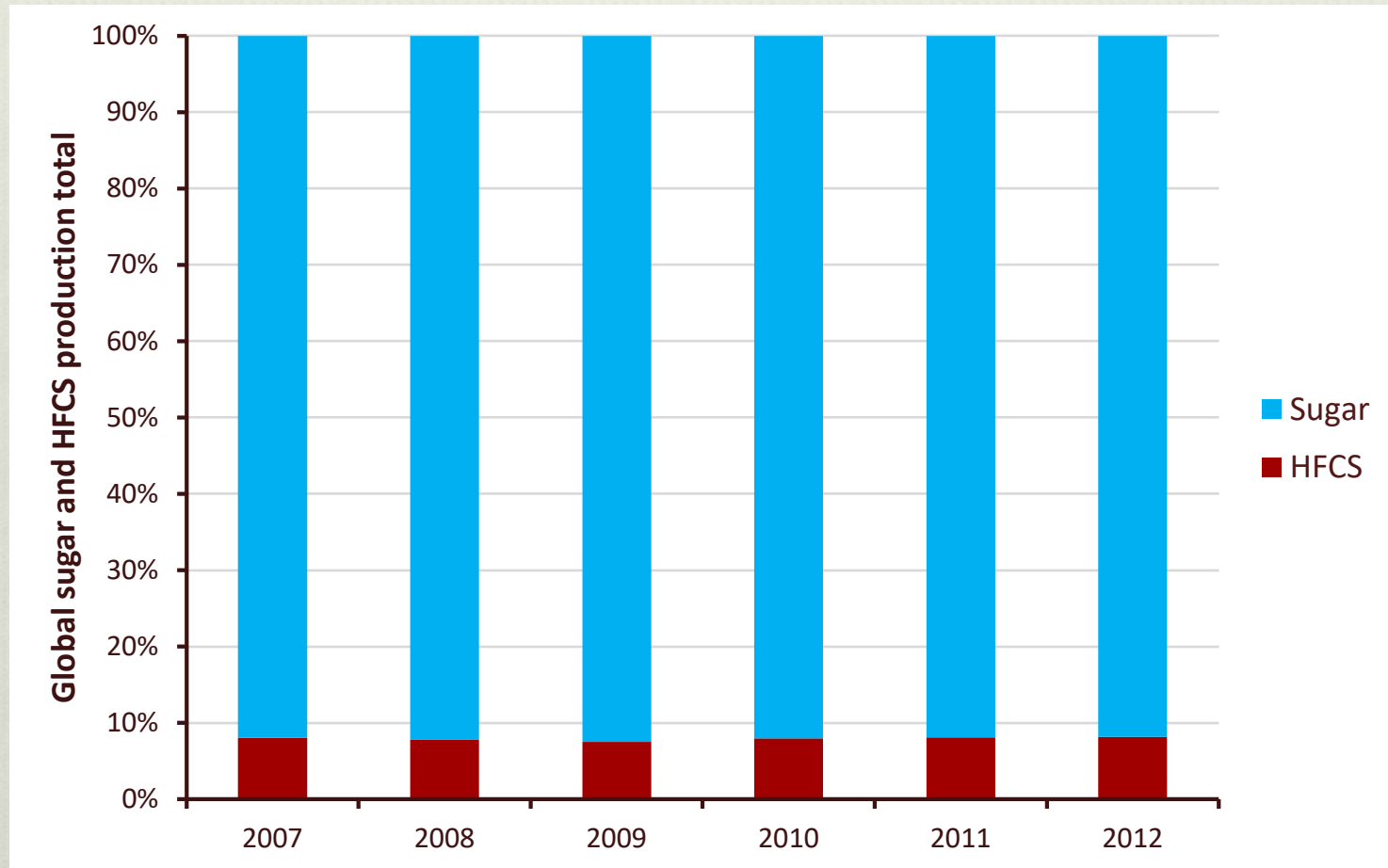
- *no correlation with increasing obesity*
- *we eat >1.7x sugar vs HFCS*



- Obesity vs. added sugars \neq correlation
- Total sugars/fructose \approx 30y ago
- 100y fructose data is 38 ± 4 g/d/capita



We live in a sugar-sweetened world: Sugar production > 10x HFCS



Calories from added sugars *are not* driving obesity

Average daily per capita calories (U.S.)

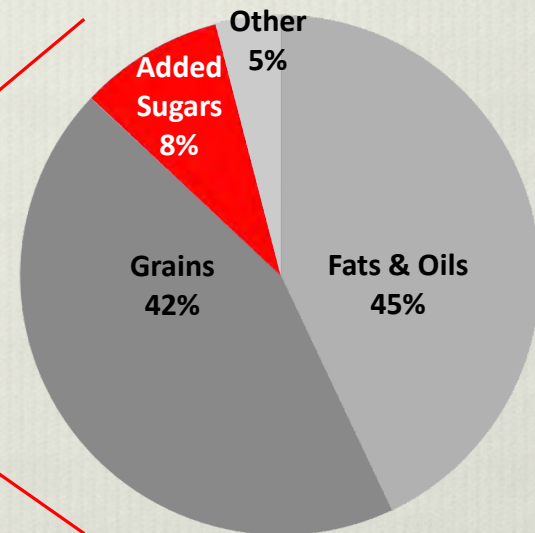
1970

2,155

2010

2,604
+449 Calories
(+21%)

Percent of 40-y calorie increase



USDA-ERS. Average daily per capita calories from the U.S. food supply, adjusted for spoilage and other waste: 1970-2010.

Note: USDA fats & oils data unavailable after 2010.

Are added sugars increasing in the diet?

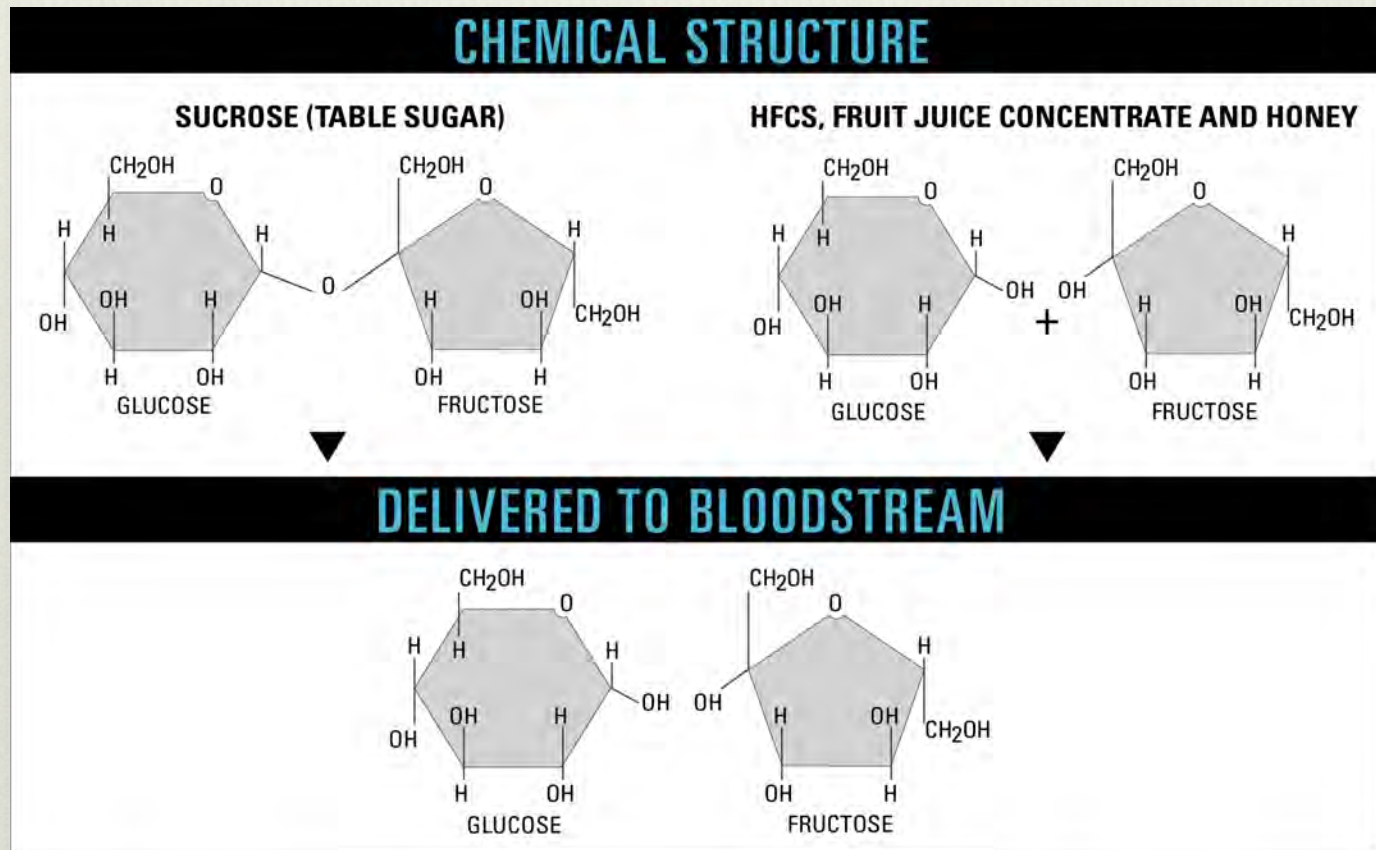
Conclusions

1. Claims that added sugars, HFCS and fructose are increasing are false – actually in decline for 19y
2. Rising obesity rates don't correlate with added sugars
3. >1.5x more sugar than HFCS is consumed in the U.S.;
>10x more sugar worldwide
4. *Sugars increase is not driving increased calorie intake:*
21% increase since 1970 is a good explanation for obesity;
≈90% of the increase came from added fats and cereal grains
5. We are eating more of *everything*

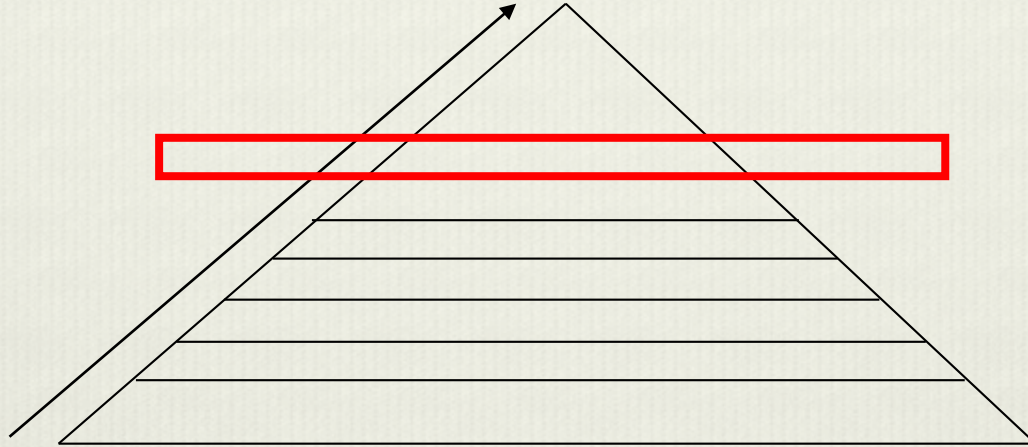
Is HFCS processing by the body
unique compared with
sucrose and other sugars?

Short-term studies

Once sugars are absorbed, the original source is irrelevant

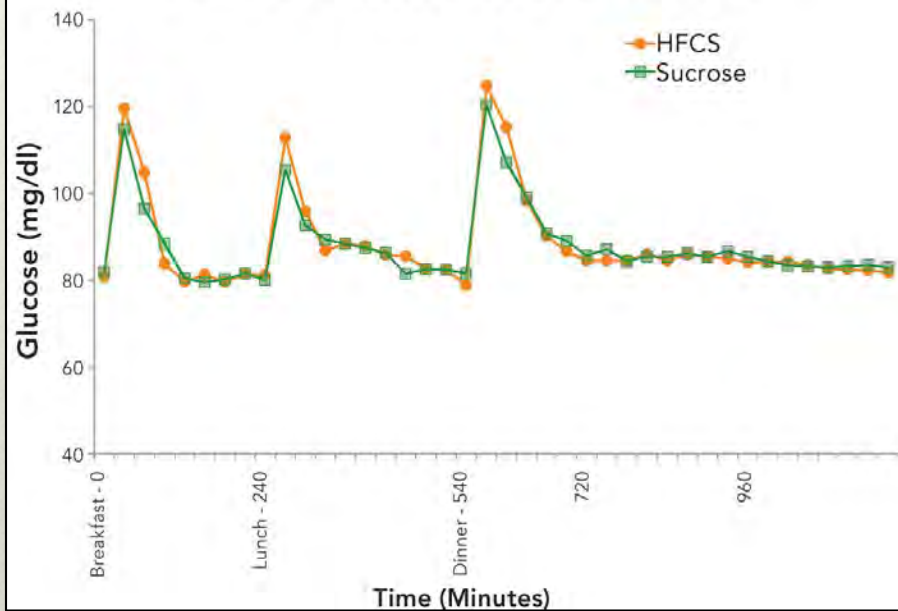


Predict: metabolism is similar, not different

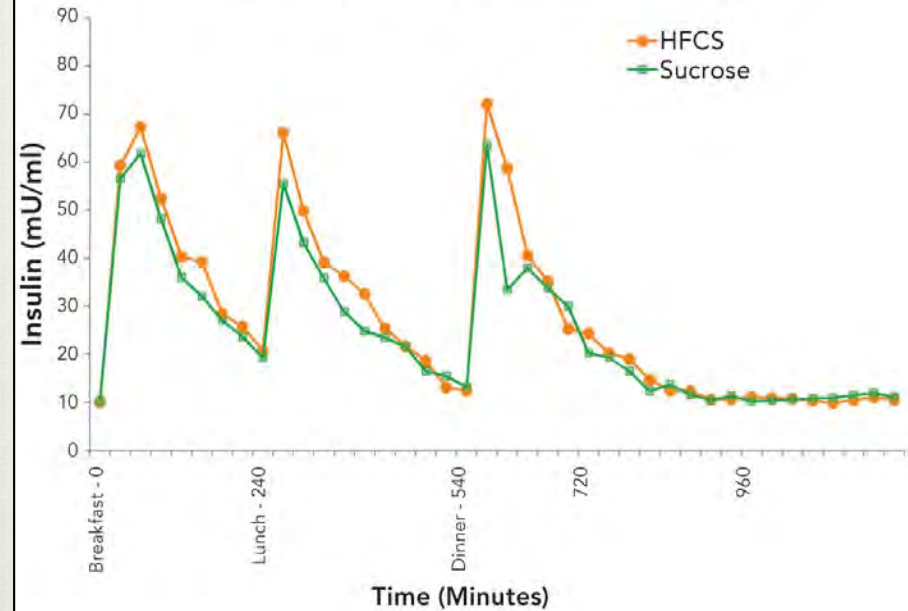


Randomized Controlled Trials [high evidentiary value]

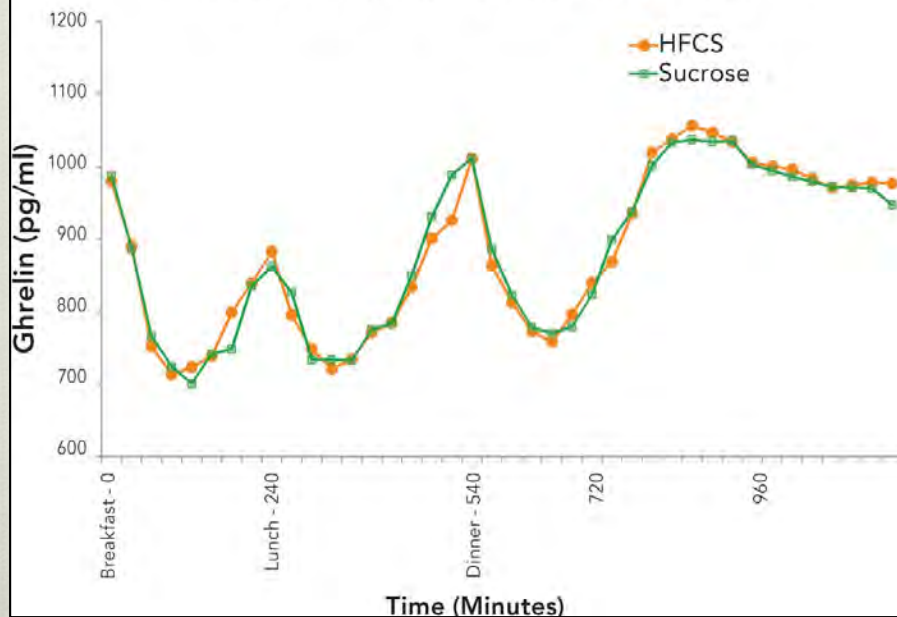
Plasma Glucose Concentrations

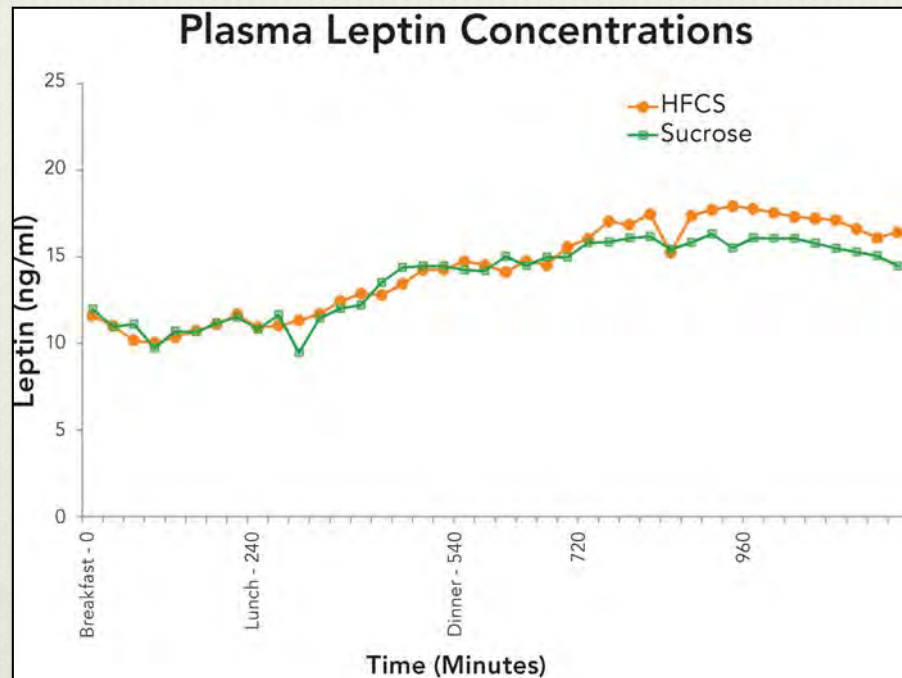


Plasma Insulin Concentrations

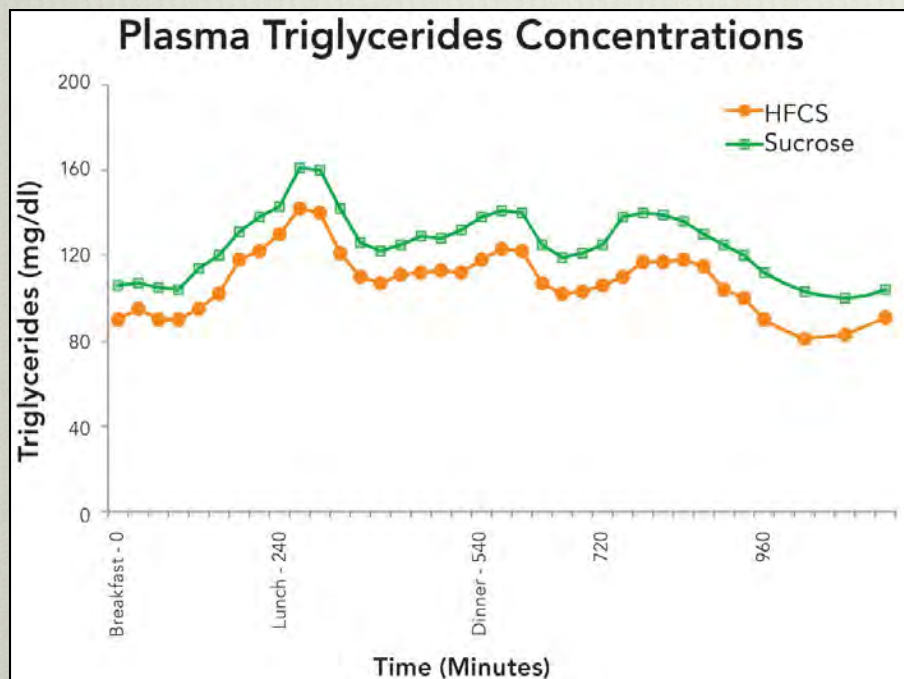


Plasma Ghrelin Concentrations

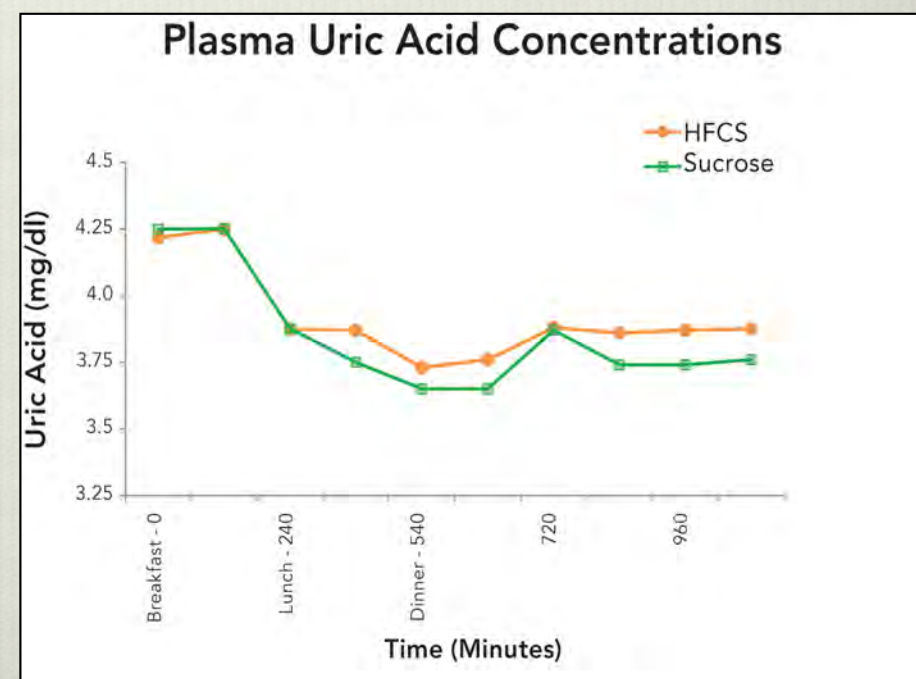




Melanson et al, 2007, *Nutrition*



Zukley et al, June 2007, Endocrine Soc Program Abstract #P2-46.

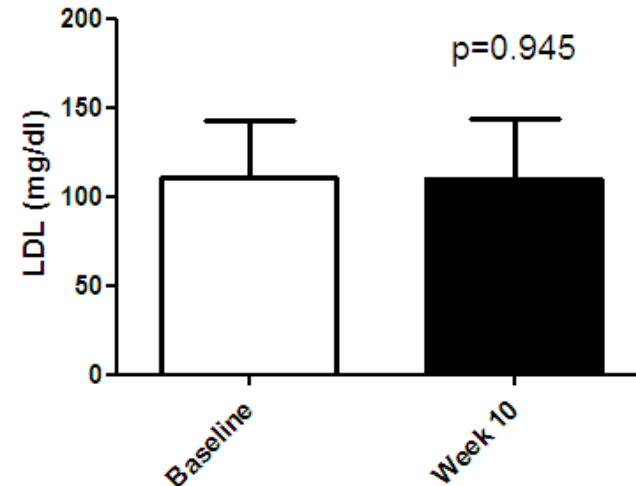
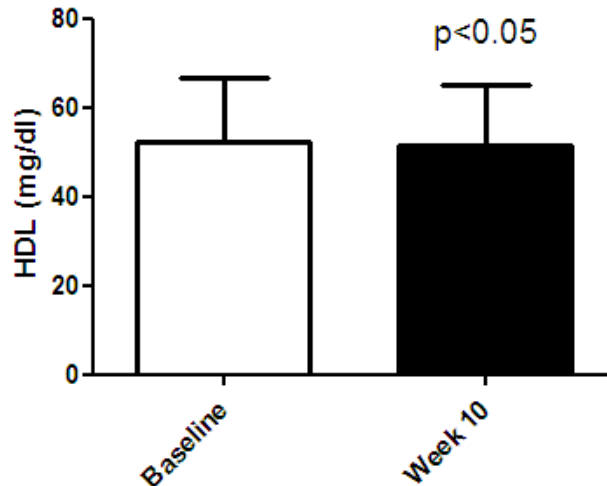
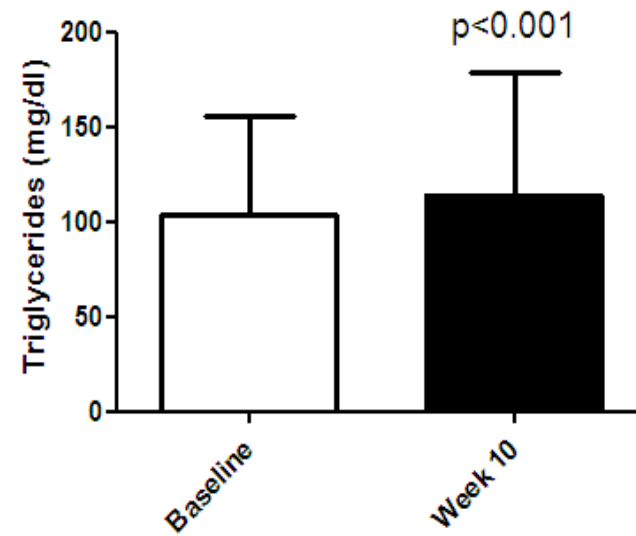
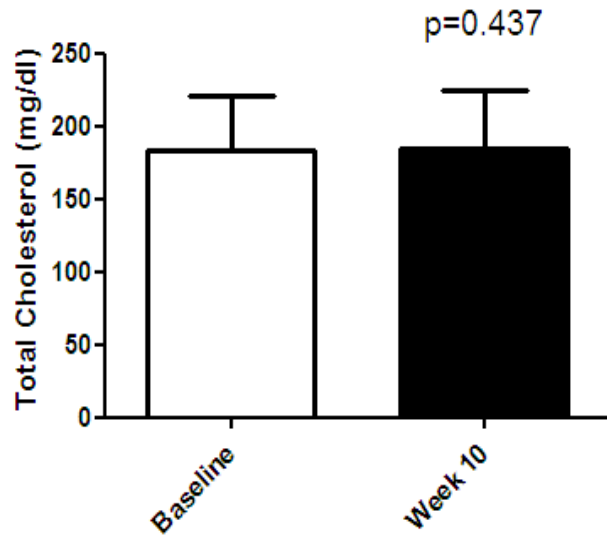


Lowndes et al, June 2007, Endocrine Soc Program Abstract #P2-45.

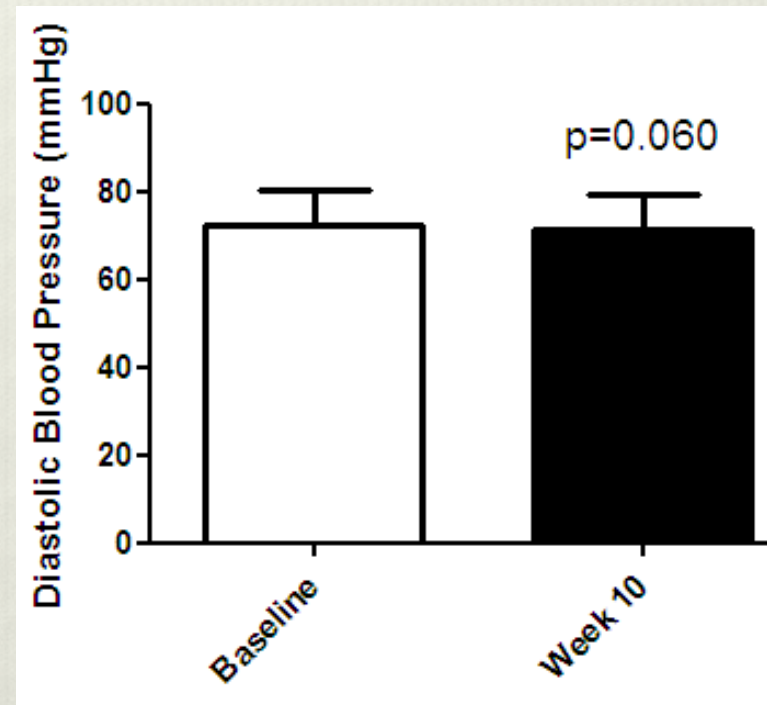
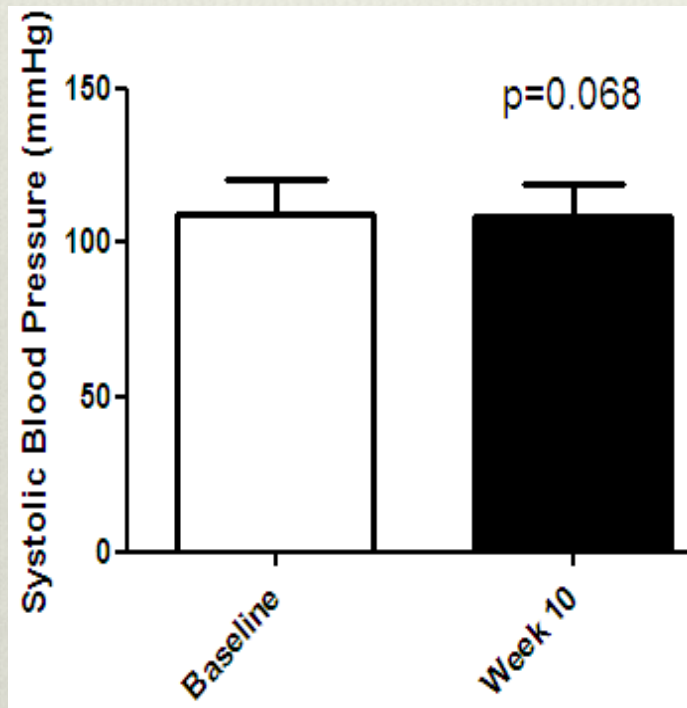
Does high value,
cause-and-effect evidence
uniquely link added sugars to
diet-related chronic diseases?

Long-term studies

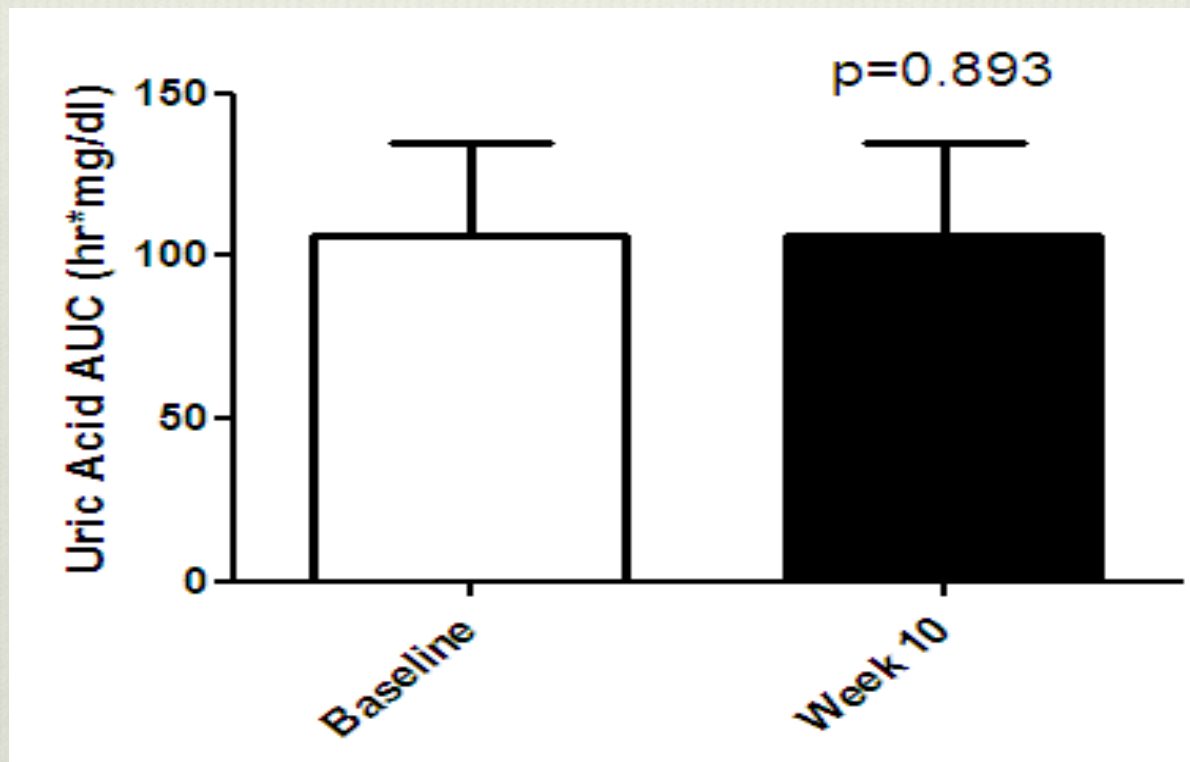
Lipid effects of HFCS or sucrose at 8, 18 or 30% of E (10 weeks; N=342)



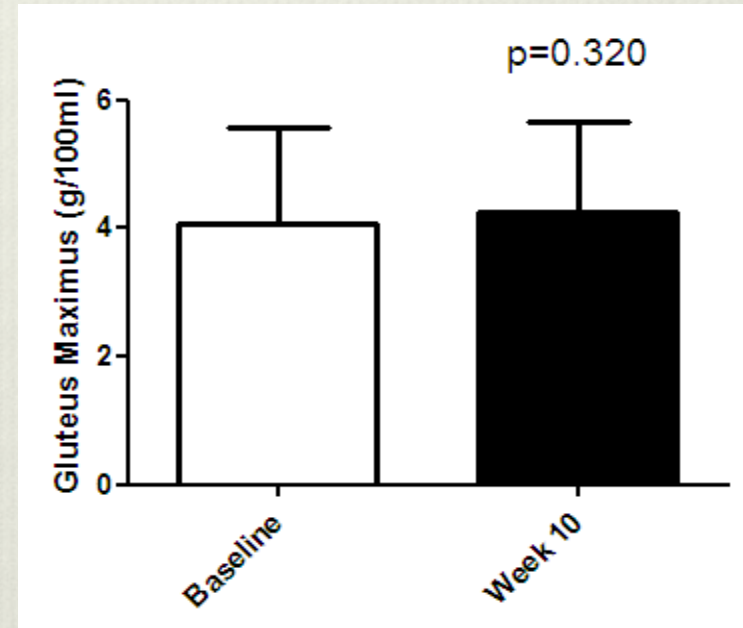
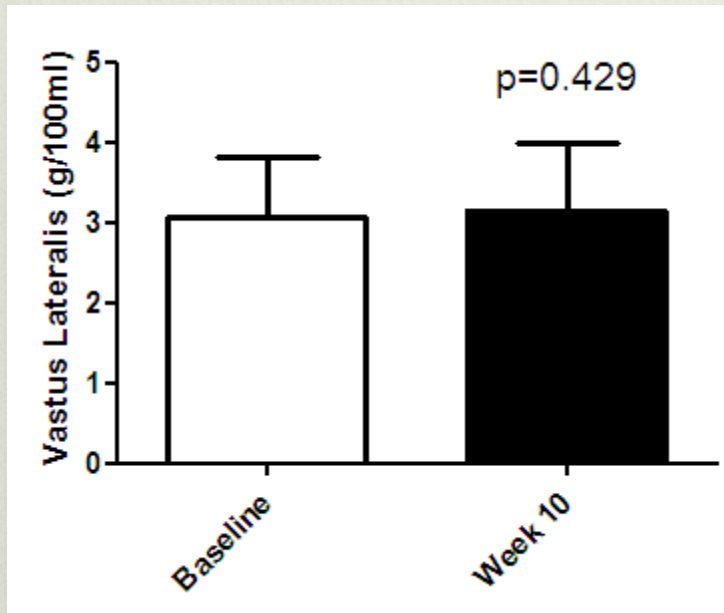
Blood pressure effects of HFCS or sucrose at 8, 18 or 30% of E (10 weeks; N=342)



Uric acid effects of HFCS or sucrose at 8, 18 or 30% of E (10 weeks; N=342)



Skeletal muscle effects of HFCS or sucrose at 8, 18 or 30% of E (10 weeks; N=342)



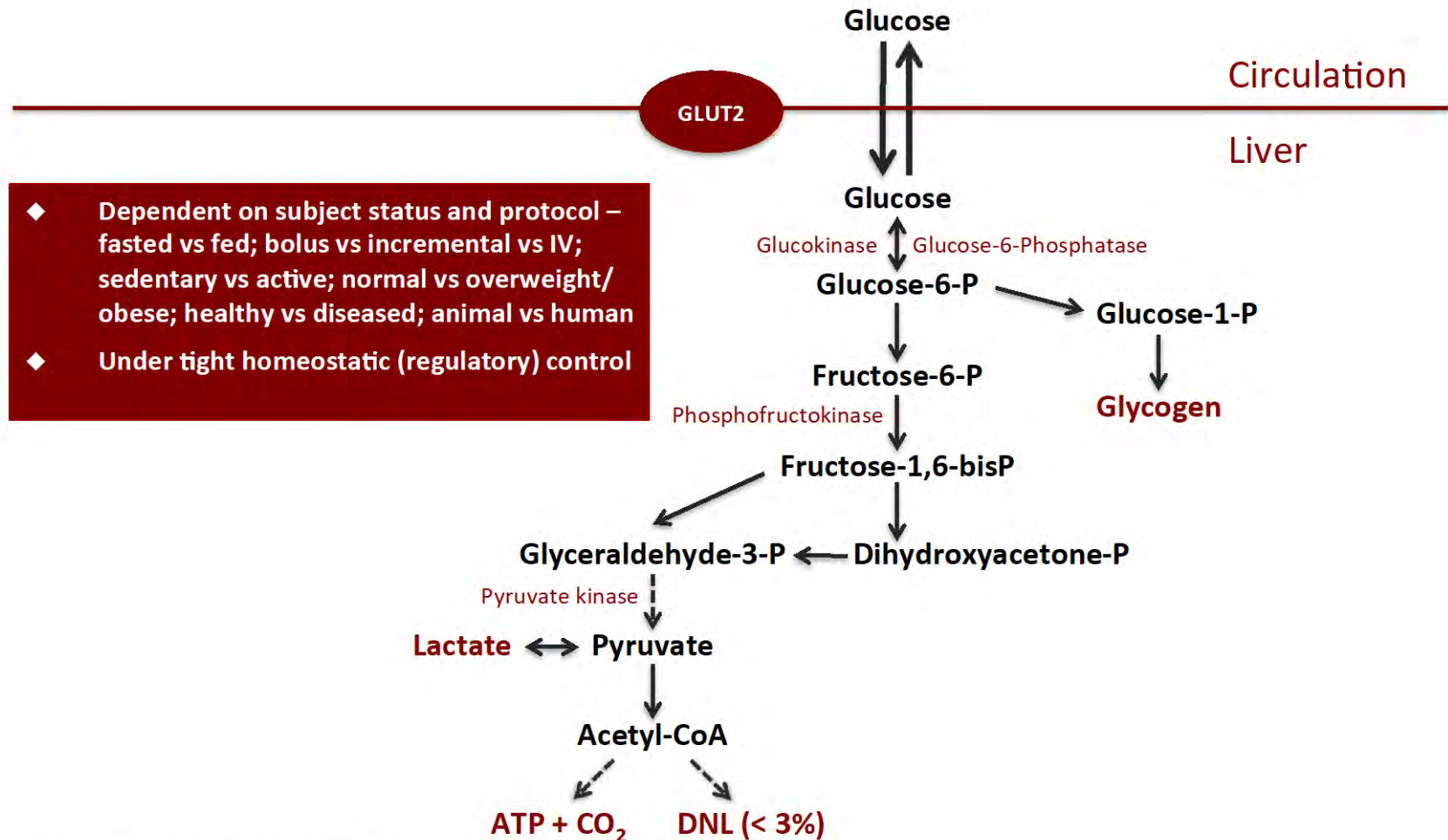
Randomized controlled trials conclusions:

*Do added sugars have long-term effects
on disease risk factors?*

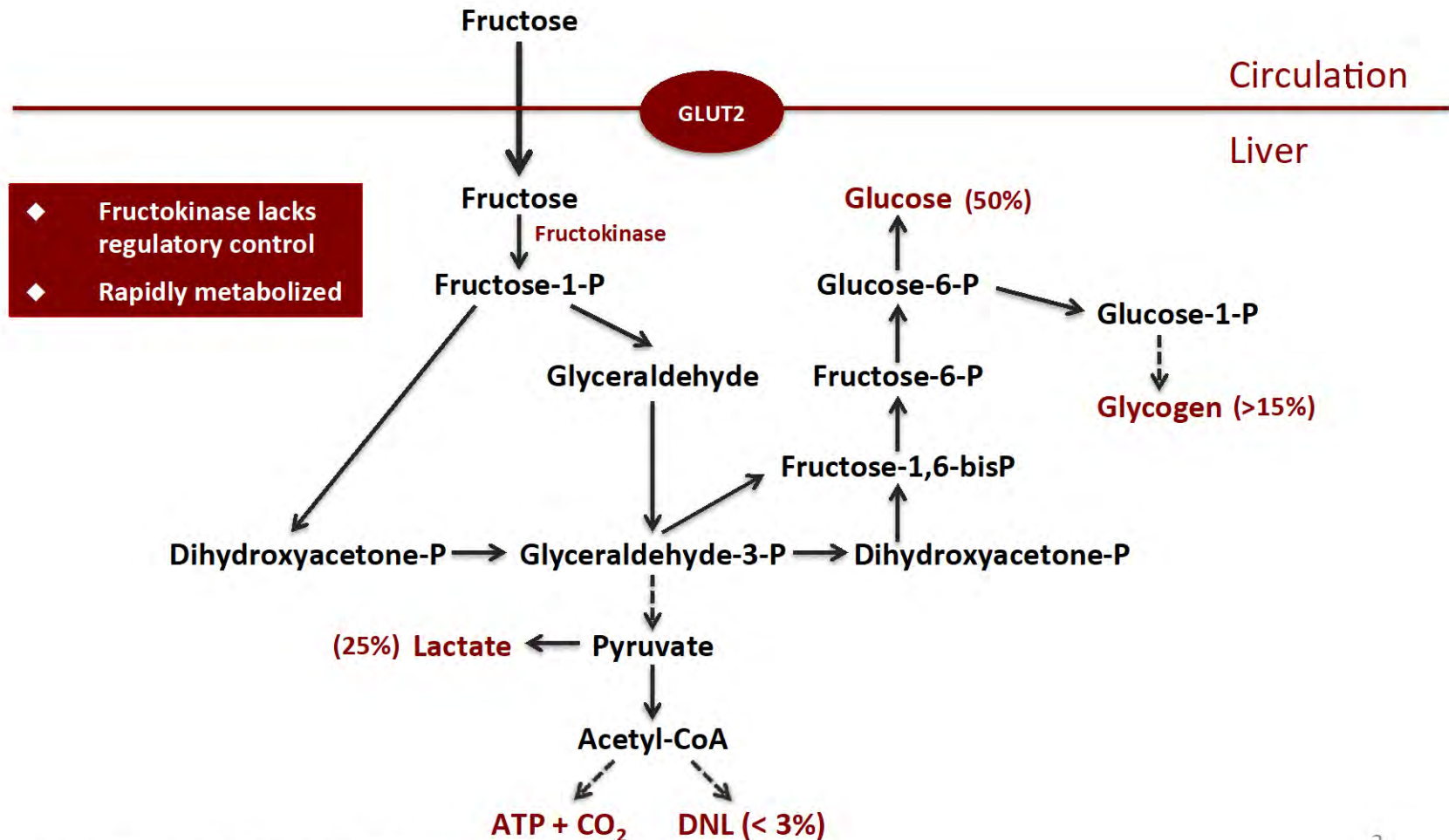
1. No significant differences between HFCS, sucrose, fructose and glucose
2. No adverse effects on:
 - Energy regulating hormones
 - Lipids
 - Blood pressure
 - Obesity risk factors (slight weight gain at highest level)
 - Diabetes risk factors
 - Metabolic syndrome risk factors

Is fructose a *good proxy*
for added sugars?

Glucose Metabolic Flow



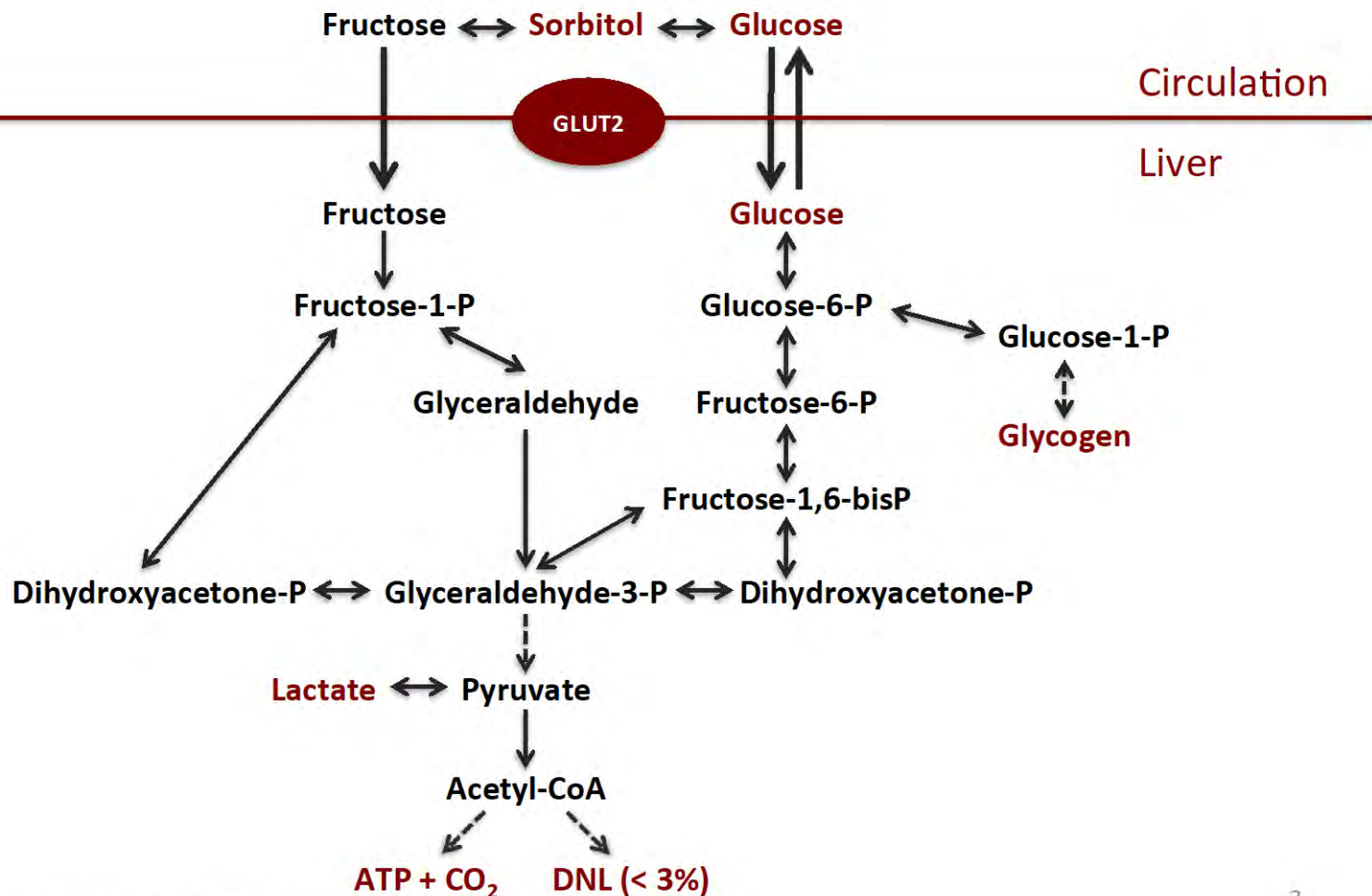
Fructose Metabolic Flow



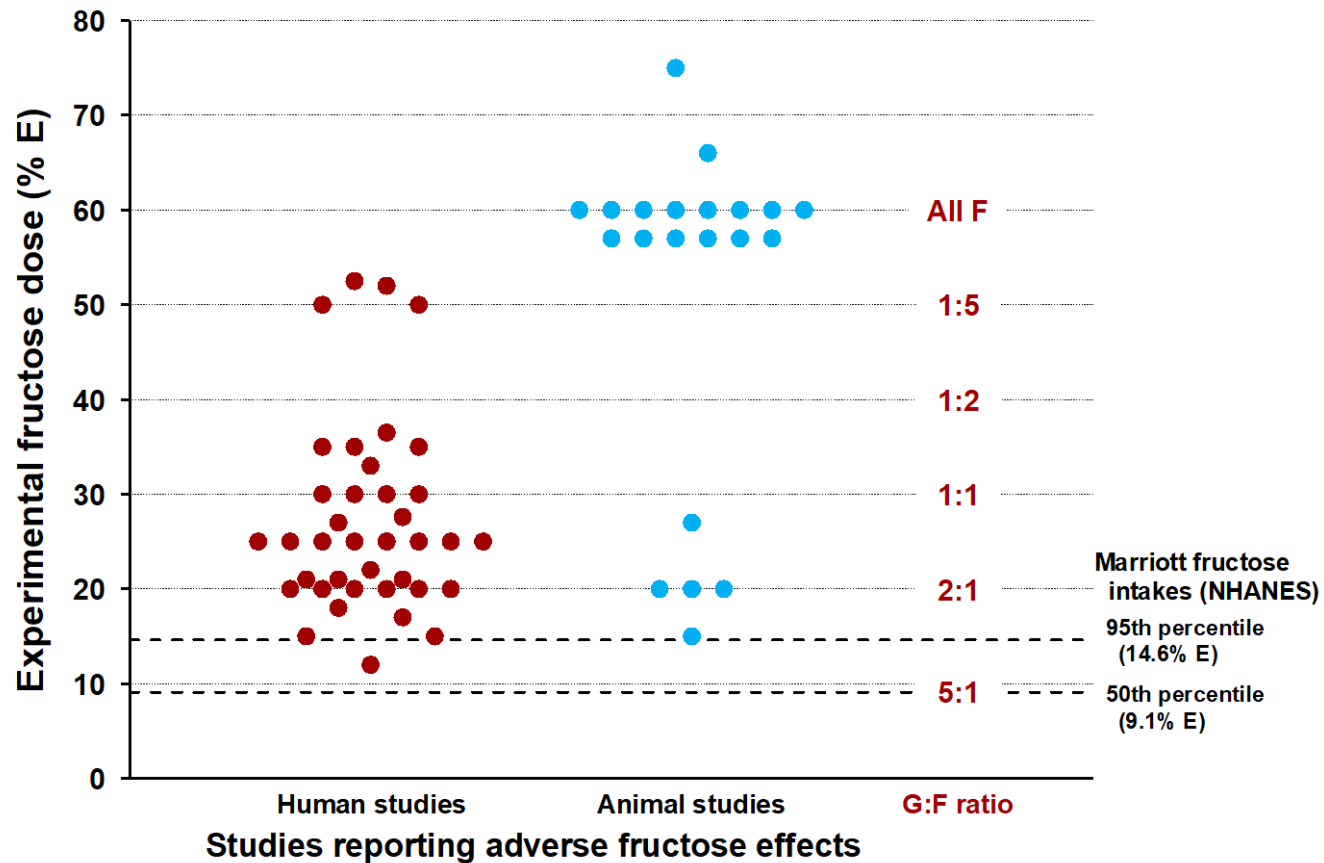
1) Fructose studies don't model consumption patterns

- ◆ Humans don't eat fructose or glucose alone...always in combination in the diet from:
 - Fruits, vegetables and nuts
 - Added sugars

Fructose + Glucose = Merged metabolism

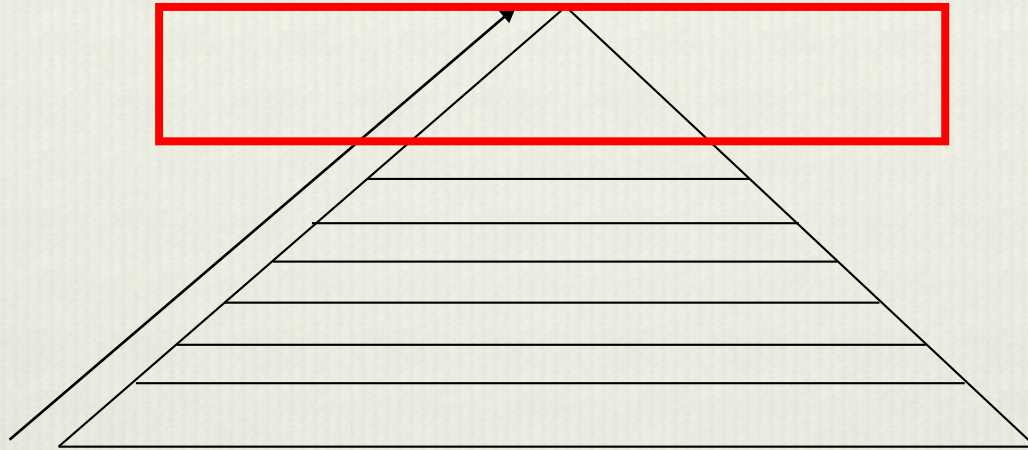


2) Fructose studies don't model the range of human intake



Are added sugars harmful?

A look at the evidence



Meta-analysis [highest evidentiary value]

*Are added sugars a unique or significant
cause of disease?*

Meta-Analysis

A statistical method of combining evidence from similarly designed randomized controlled studies to provide an understanding of relative risk from a specific treatment.

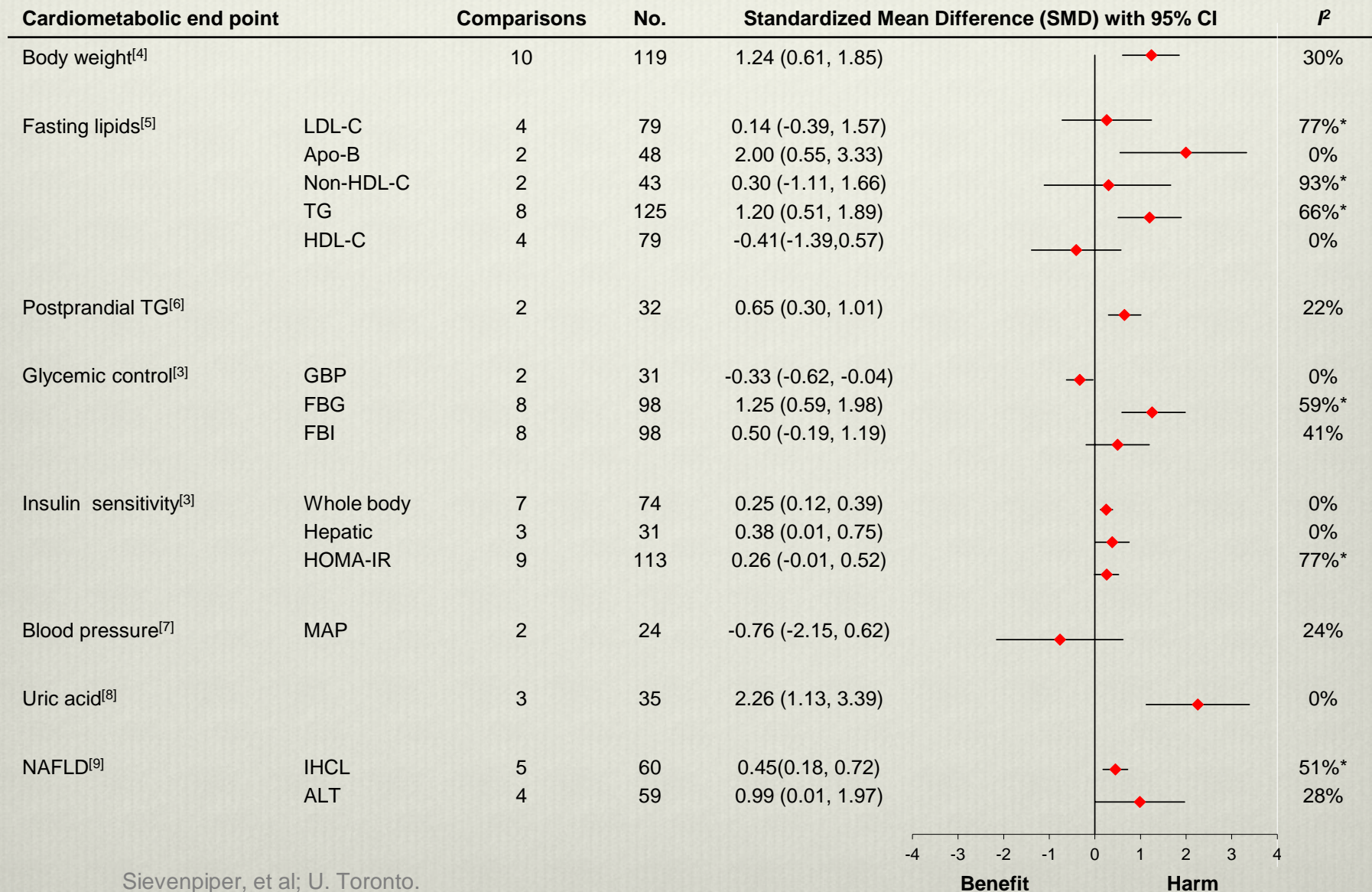
First condition – Addition trials

Comparisons are *unmatched* for energy:
energy from fructose is added to the diet

Hypercaloric

Hypercaloric comparisons with any CHO

Harmful effect due to excess E (max +250 g/d; +50% E)



Meta-Analysis

A statistical method of combining evidence from similarly designed randomized controlled studies to provide an understanding of relative risk from a specific treatment.

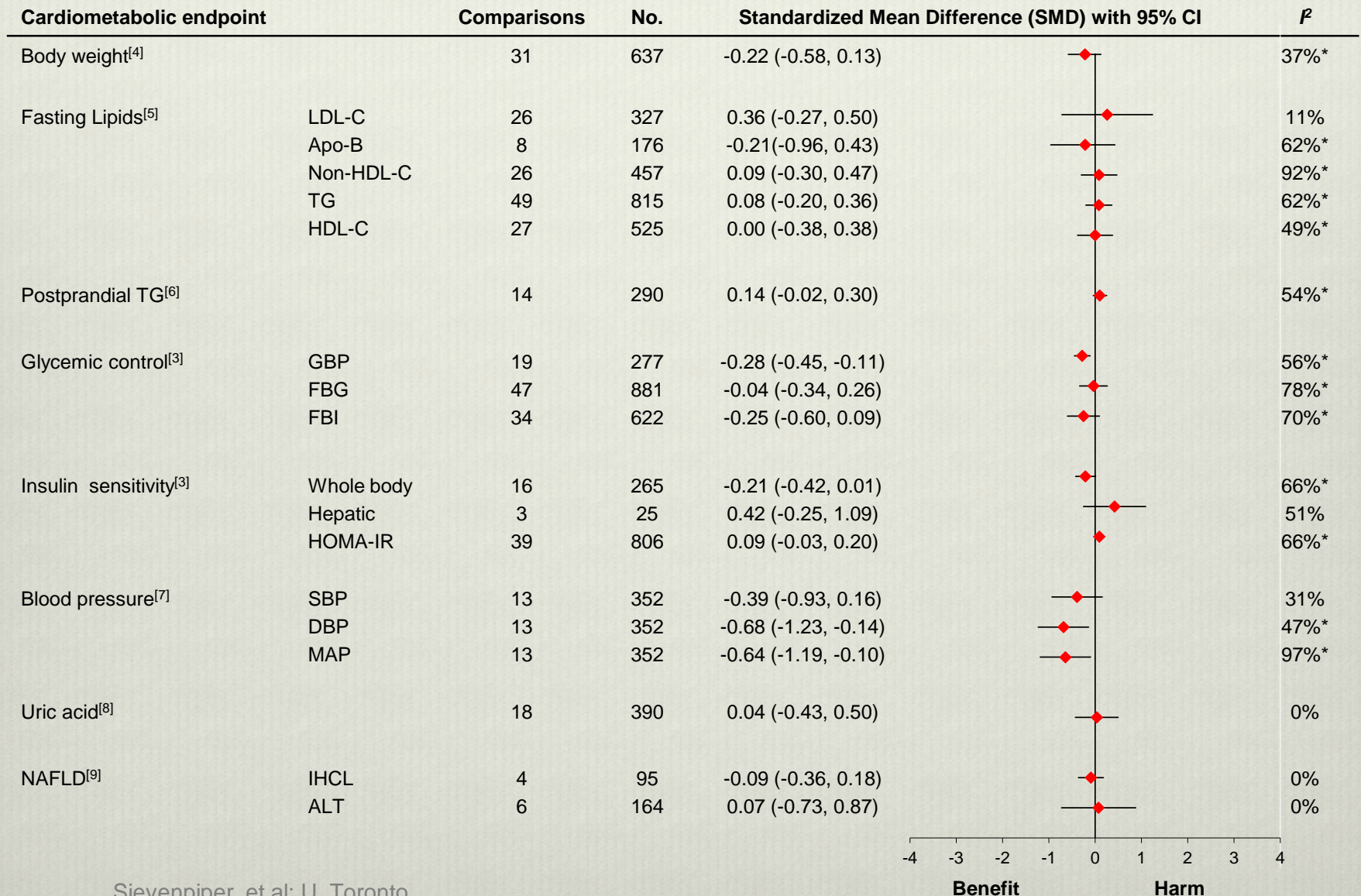
Second condition – Substitution trials

Comparisons are *matched* for energy:
fructose is substituted for other sources of carbohydrate in the diet

Isocaloric

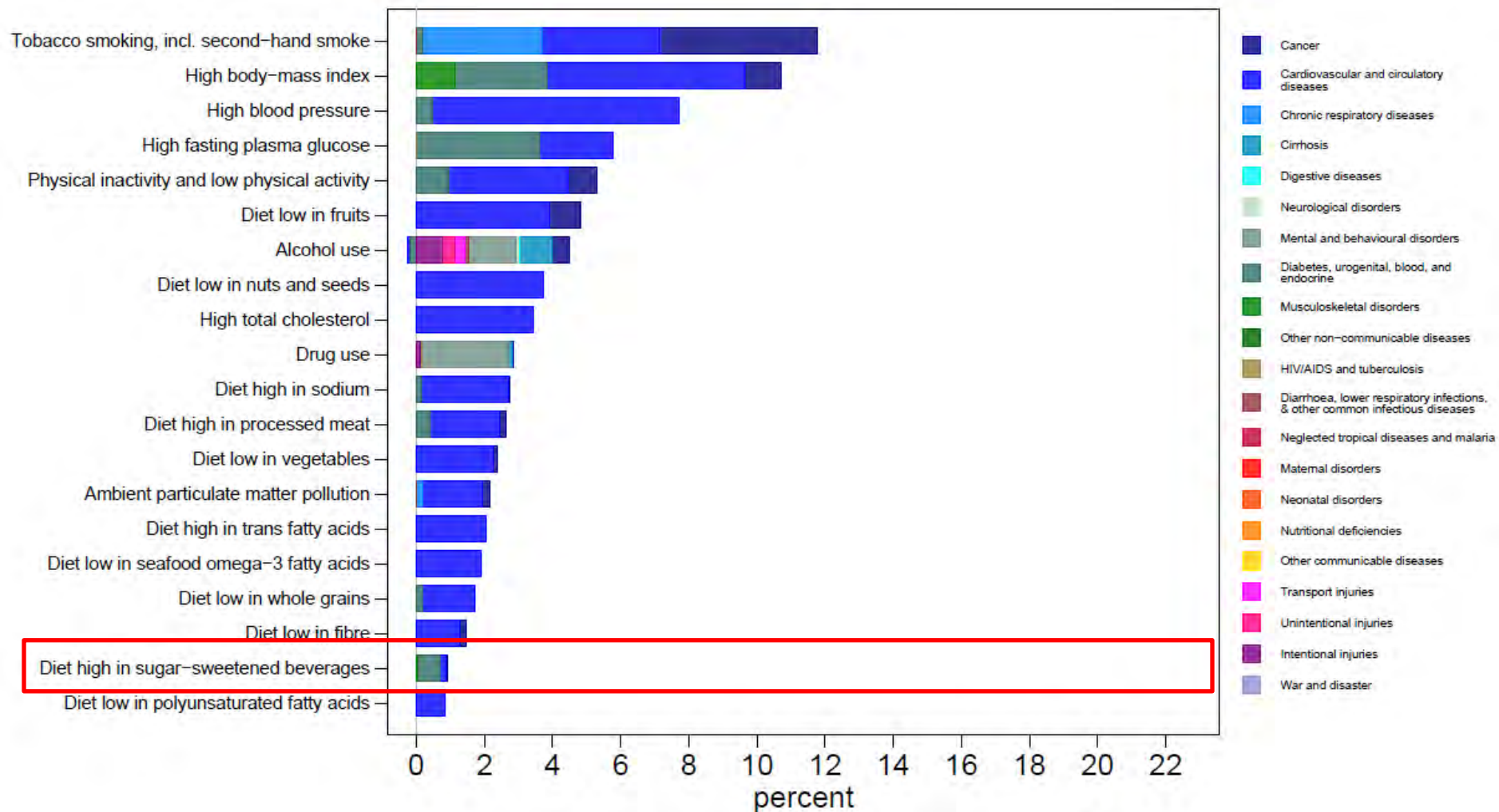
Isocaloric comparisons with any CHO

> 50 trials (N>1000); dose = 22-300 g/d; 1-52 wk follow-up



Population attributable burden of disease for 20 leading risk factors in North America in 2010

How do sugar sweetened beverages compare?



Meta-Analysis conclusions:

Are added sugars a unique or significant cause of disease?

- ◆ Effects of added sugars are small and lack demonstrated harm in comparison with other sources of excess energy in the diet and common lifestyle choices.
- ◆ Effects on body weight or disease risk are highly dependent on energy balance and nutrient adequacy.
- ◆ There are many pathways to overconsumption leading to weight gain and downstream consequences. The greatest risk occurs when these pathways converge.
- ◆ Attention should focus on reducing overconsumption of *all* caloric foods, promoting healthier dietary patterns, and increasing physical activity.

Conclusions from the *Added Sugars Hypothesis*

1. Significant diseases related to intermediary metabolism **are increasing** around the world.
2. Added sugars **do contribute** calories but no essential nutrients.
3. Added sugars **are not increasing** in the human diet.
4. HFCS processing by the body **is not unique** compared with sucrose and other sweeteners.
5. Fructose **is not a good proxy** for added sugars.
6. High value, cause-and-effect evidence **does not uniquely** link added sugars metabolism to these diseases in humans at typical exposure levels and patterns.
7. Considering the disproportionate increase in consumption of added fats and cereal grains over the past 50y, **it is unlikely reducing added sugars** will reverse the trend toward overweight and obesity.

Questions...?