Are Vegetable Seed Oils Fueling the Obesity Epidemic?

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The Caloric Imbalance Puzzle

Standard Model: Most economic models predict obesity from caloric imbalance (Cutler et al., 2003)

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- Obesity rates

Stable/Declining

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- Sugar intake
- Sedentary behavior

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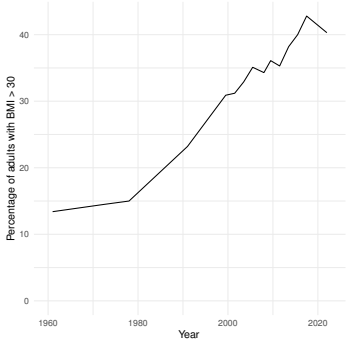
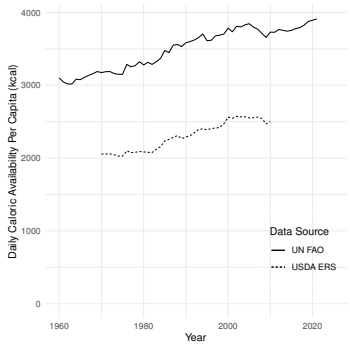
Central Questions:

- How do seed oils cause obesity?
- What are the economic incentives driving ↑ seed oils?

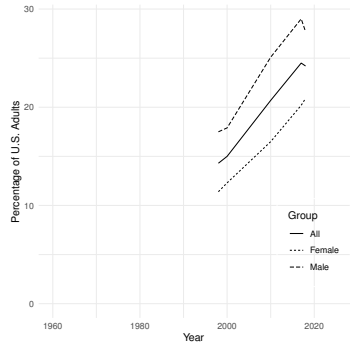
Obesity Rises While Calories and Exercise Remain Stable



Obesity



Calories



Exercise

Sources: NHANES, USDA, UN FAO Stat, CDC

Dietary Composition Affects Metabolic Efficiency

- Standard models assume metabolism (Calories Out) is fixed
- But dietary composition (Calories In) affects metabolism (Calories Out)
  - In general, Calories Out is endogenous (Pontzer et al., 2012)

Seed Oils Disrupt Metabolism Through Multiple Pathways

Seed Oils: Soybean, corn, canola, sunflower, safflower, cottonseed, rice bran, grapeseed

- High in ω-6 Polyunsaturated Fats (PUFAs)—mainly linoleic acid
- In virtually every Ultra Processed Food (UPF)

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Proposed Mechanisms:

Dietary ω-6 PUFA alters food consumption signalling pathways to promote excess calorie consumption and fat storage

$$\begin{aligned} \text{Excess } \omega\text{-6 PUFA} &\rightarrow \text{Endocannabinoid signaling} &&\rightarrow \text{Appetite dysregulation} \\ &\rightarrow \text{Lipid peroxidation} &&\rightarrow \text{Mitochondrial dysfunction} \\ &\rightarrow \text{Inflammatory cascades} &&\rightarrow \text{Metabolic stress} \end{aligned}$$

Identification: Triangulating Evidence to Isolate ω-6 PUFA Effects

Challenge: Observational studies confound multiple dietary changes

Solution: Triangulation across multiple study designs

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1. **Animal RCTs**: Multiple species, controlled conditions, dose-response
2. **Human medical interventions**: Obesity treatments target ω-6 pathways
3. **Temporal analysis**: Historical seed oil supply vs. obesity / fat comp. trends

Key insight: Focus on linoleic acid (primary ω-6 PUFA in seed oils) as treatment variable

Animal Studies Are Consistent With Proposed Mechanisms

Mouse RCTs (Alvheim et al., 2012, 2014):

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- Same calories, different fat composition $\rightarrow$ different obesity outcomes

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- High ω-6 feeds systematically fatten livestock
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Human results consistent with animal studies:

- Ensure^{TM} has similar composition as lab food for animal obesity induction
- Pro- and Anti-obesity drugs work in animals just like humans (Ye et al., 2020)

Obesity treatments work on ω-6 / endocannabinoid pathways

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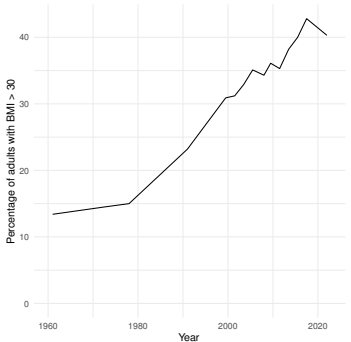
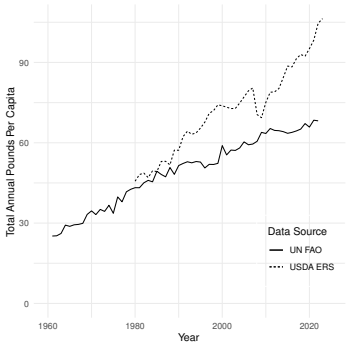
Epidemiological evidence on high-ω-6 foods (Mozaffarian et al., 2011):

- Foods with added seed oils are most obesogenic
- e.g. French fries/potato chips but not other potato-based foods

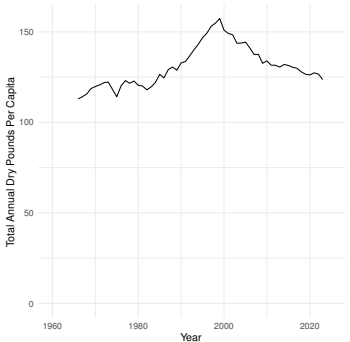
Seed Oils Track Obesity Better Than Calories or Sugar



Obesity



Seed Oil Supply



“Caloric Sweetener” Supply

Sources: NHANES, USDA, UN FAO Stat

Linoleic Acid Is Increasing Share of Body Fat in Humans

Body Composition (Guyenet and Carlson, 2015):

- Linoleic acid in fat tissue: $\approx$ 10% to $\approx$ 22% (1960–2010)
- Tracks closely with obesity epidemic timing

Economic Incentives Drive Seed Oil Proliferation

Information (Diet-Heart Hypothesis, 1960s–80s):

- Saturated fat demonized $\rightarrow$ industry sought alternatives
- First switch: trans fats (partially hydrogenated seed oils)
- Second switch: “healthier” liquid seed oils

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Production Economies:

- Economies of scale & scope; cheaper than animal fats
- Longer post-processing shelf life $\rightarrow$ reduced spoilage costs
- Grain/soy livestock feed $\rightarrow$ higher ω-6 in meat, eggs, dairy

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Consumption Lock-in:

- Habit persistence in food choices
- Ubiquity in processed foods creates path dependence

Political Economy Dynamics

Regulatory & Information Capture:

- Industry funding influences nutrition & medical research
- “Heart-healthy” messaging benefits seed oil producers
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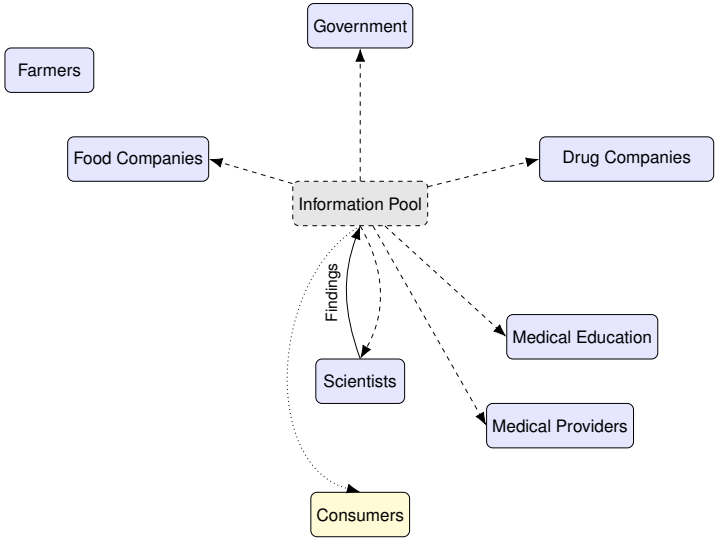
Information Problem Persists:

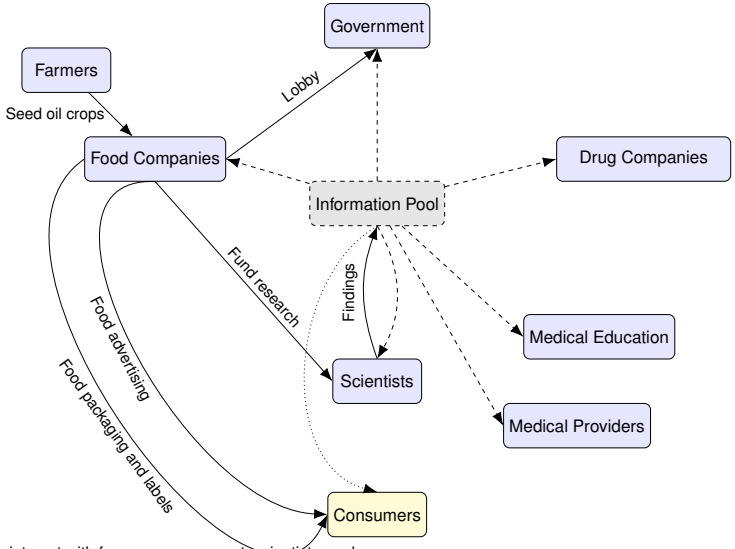
- NHANES Healthy Eating Index penalizes saturated fat
- Popular mobile apps (Yuka) penalize saturated fat
- Government guidelines reinforce outdated diet-heart hypothesis

Information & Incentive Flows



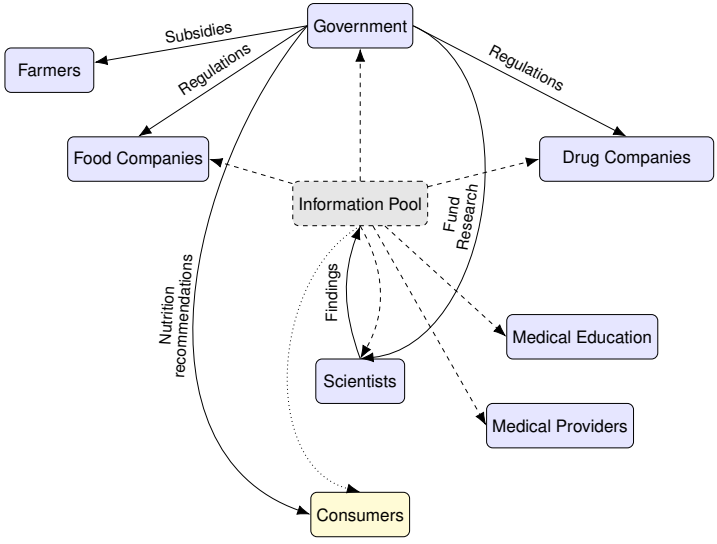
Scientists contribute findings to the information pool

Information & Incentive Flows



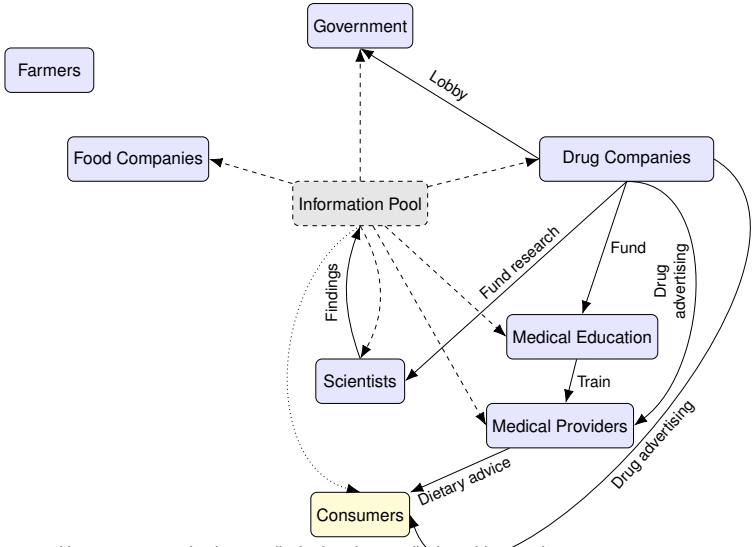
Food companies interact with farmers, government, scientists, and consumers

Information & Incentive Flows



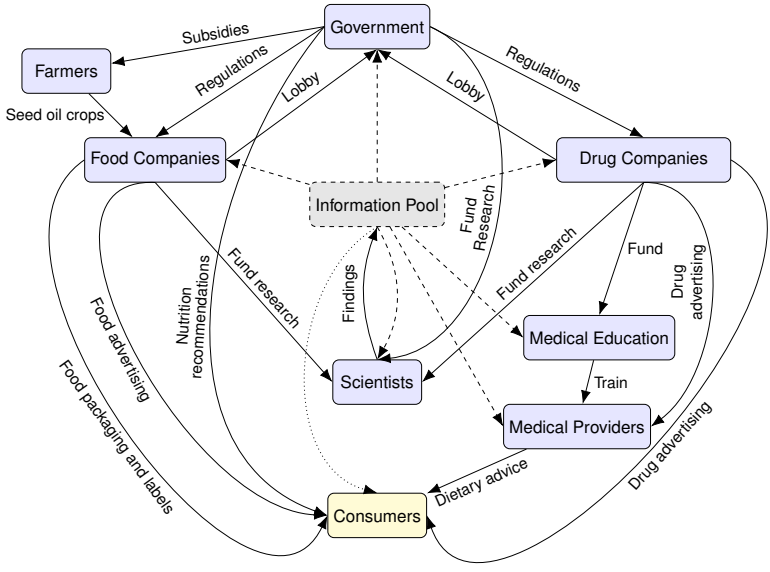
Government subsidizes farmers, regulates food and drug companies, funds science, gives info to consumers

Information & Incentive Flows



Drug companies interact with government, scientists, medical education, medical providers, and consumers

Information & Incentive Flows



Role for Health Economists

Reframe the Problem: Move beyond calories, sugar, saturated fat, and "ultra processed food" to focus on ω-6 PUFAs

- **Welfare Analysis**: Calculate optimal Pigouvian ω-6 tax; dominates sugar taxes for obesity (Cawley et al., 2019; Aguilar et al., 2021)
- **Empirical Challenges**: Gradual ω-6 effects rule out standard causal inference techniques; requires structural modeling or long-panel analysis
- **Information Design**: Evaluate ω-6 PUFA disclosure labels using randomized controlled trials and choice experiments (Downs et al., 2015)
- **Producer Incentives**: Estimate supply-side elasticity of reformulation to consumer demand vs. regulatory pressure (Barahona et al., 2023)

Bottom Line: Market-driven vs. policy-driven solutions depend on consumer responsiveness and industry structure

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