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Session 157: Beyond Nutrients? Potential role of ultra-processed foods in obesity

Disclosures for Dr. Hall and Dr. Courville

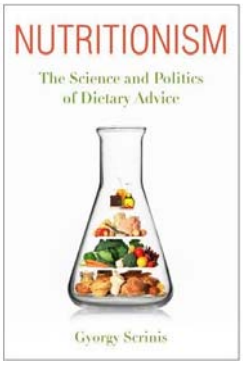
- Required: Employer
  - National Institutes of Health
- Board Member/Advisory Panel
  - None
- Consultant
  - None
- Employee
  - National Institutes of Health
- Research Support
  - Intramural Research Program of the National Institutes of Health
- Speaker's Bureau
  - None
- Stock/Shareholder
  - None

Learning Outcomes

At the end of this session, the participant will be able to:

- describe the concept of an ultra-processed food
- understand the NOVA food classification system
- describe the potential role of ultra-processed foods in obesity
- describe the process of creating and providing highly controlled metabolic diets that differ in processing

Diet Quality & "Nutritionism"



Nutritionism – or nutritional reductionism – is characterized by a reductive *focus* on the nutrient composition of foods as the means for understanding their healthfulness, as well as by a reductive *interpretation* of the role of these nutrients in bodily health.

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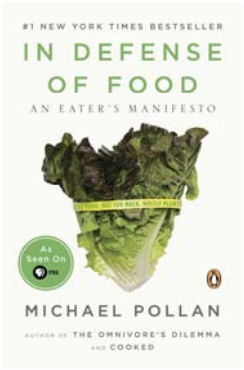
Diet Quality & "Nutritionism"



In the case of nutritionism, the widely shared but unexamined assumption is that the key to understanding food is indeed the nutrient. Put another way: Foods are essentially the sum of their nutrient parts.

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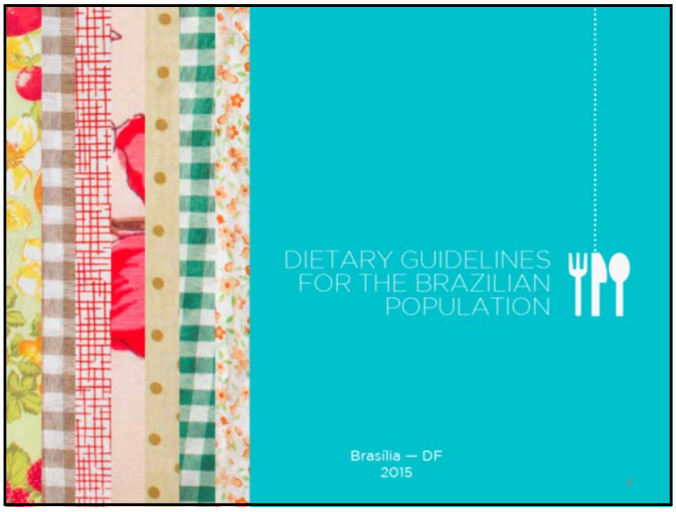
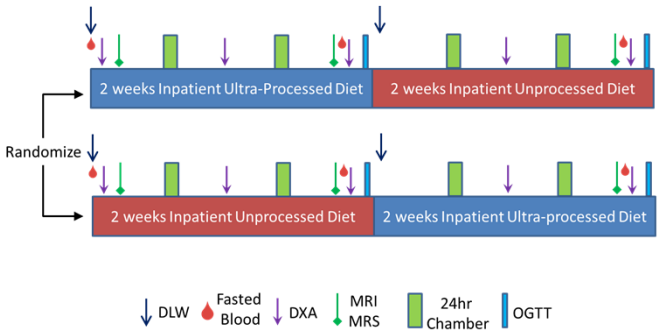
World Nutrition Volume 7, Number 1-3, January-March 2016

The *NOVA* star is born

Top: fruits; grains and legumes; meat stew with beans and vegetables; water.
Then: fruit flavour popsicles; breakfast 'cereals'; reconstituted meat product; soft drinks.
The ultra-processed products below are not variants of the foods and meal above.
They are formulated from industrial ingredients and contain little or no intact foods.
By their nature they are unhealthy, and should be grouped together, and avoided



Ultra-processed vs Unprocessed Diet Study



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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Diet Quality & Ultra-processed Food

Unprocessed or minimally processed foods include fresh, dried, or frozen vegetables, grains, legumes, fruits, meats, fish, eggs, and milk. They are the basis of healthy dishes and meals.

Ultra-processed foods include fast food, sugary drinks, snacks, chips, candies, cookies, sweetened milk products, sweetened cereals, and sauce and dressings. They are nutritionally poor.

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	Ultra-Processed Diet	Unprocessed Diet
Three Daily Meals		
Energy (kcal/day)	3,905	3,871
Carbohydrate (%)	49.2	46.3
Fat (%)	34.7	35.0
Protein (%)	16.1	18.7
Energy density (kcal/g)	1.024	1.028
Non-beverage energy density (kcal/g)	1.957	1.057
Sodium (mg/1,000 kcal)	1,997	1,981
Fiber (g/1,000 kcal)	21.3	20.7
Sugars (g/1,000 kcal)	34.6	32.7
Saturated fat (g/1,000 kcal)	13.1	7.6
Omega-3 fatty acids (g/1,000 kcal)	0.7	1.4
Omega-6 fatty acids (g/1,000 kcal)	7.6	7.2
Energy from unprocessed (%)[a]	6.4	83.3
Energy from ultra-processed (%)[a]	83.5	0

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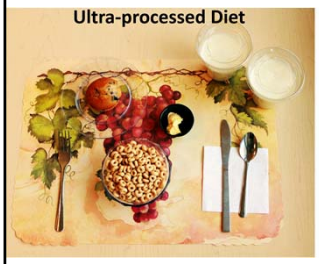
Ultra-processed vs Unprocessed Diets



The meals had similar amounts of:
Calories, Carbs, Fat, Protein, Sugar, Sodium, Fiber

20 Adults were instructed to eat as much or as little as desired

Primary Outcome: Energy Intake Differences

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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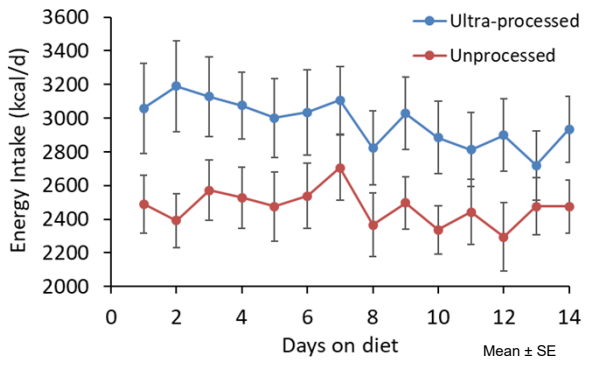
Ultra-processed Diets Cause Increased Intake



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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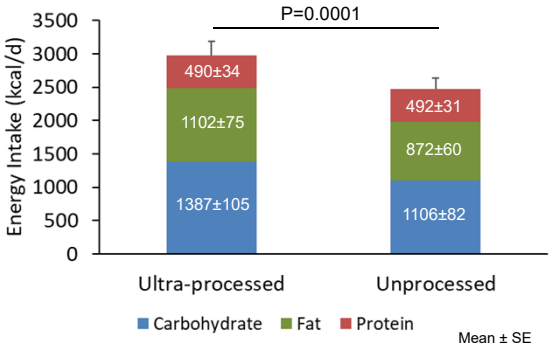
More Carbs & Fat with Ultra-processed Diets



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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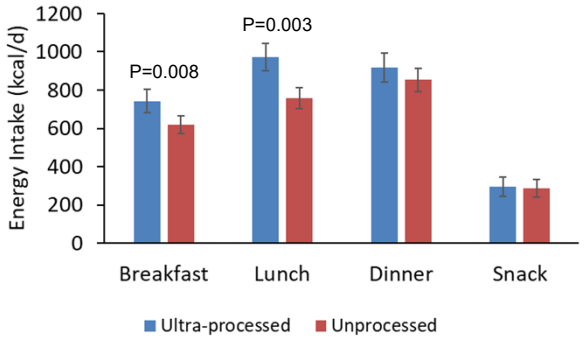
Larger Meals with Ultra-processed Diets



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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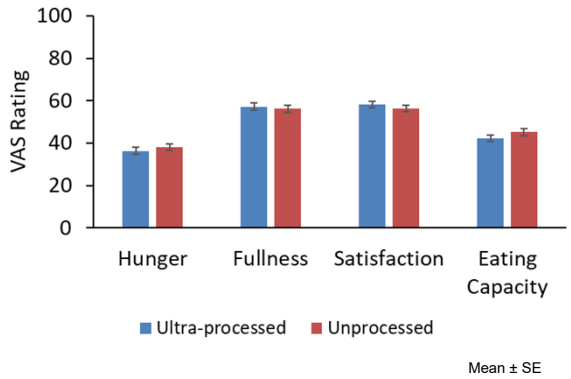
No Differences in Self-Reported Appetite



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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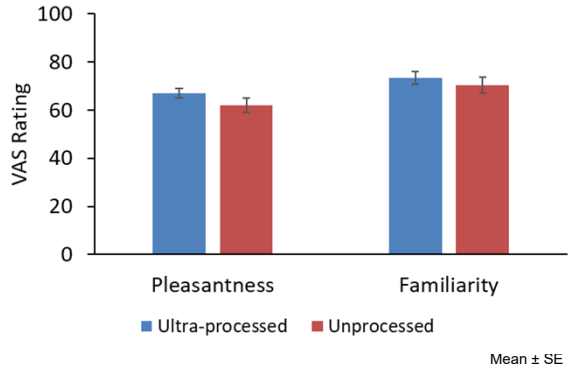
No Differences in Pleasantness or Familiarity



Mean ± SE

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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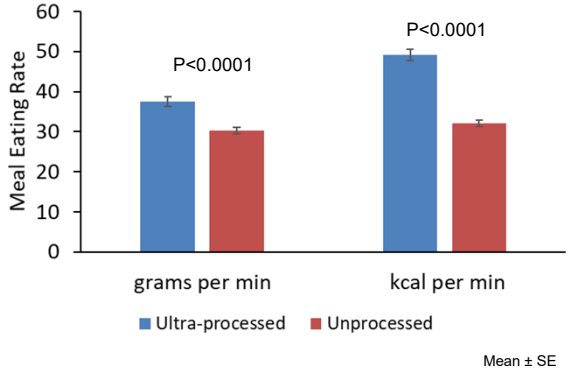
Faster Eating Rate for Ultra-processed Meals



Mean ± SE

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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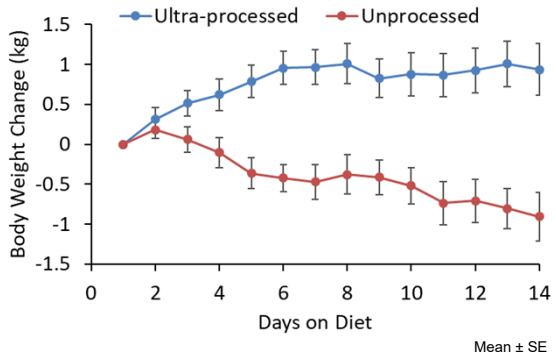
Ultra-processed Diets Cause Weight Gain



Mean ± SE

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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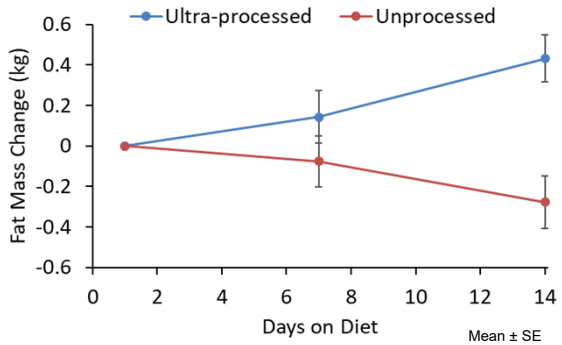
Ultra-processed Diets Cause Fat Gain



Mean ± SE

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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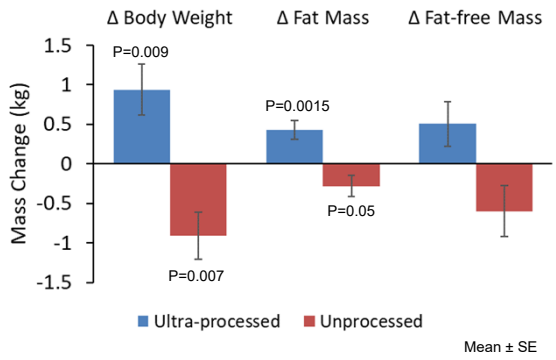
Weight & Fat Gain with Ultra-processed Diets



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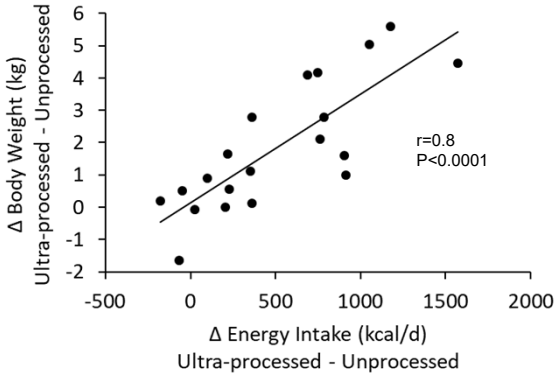
Substantial Individual Variability



KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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Key Questions:

- What are the mechanisms by which ultra-processed versus unprocessed diets influence calorie intake?
  - Not Salt, Sugar, Fat, or Fiber?
  - Not Palatability?
  - Energy Density of Non-Beverage Foods?
  - Oro-sensory properties & Eating Rate?
  - Hormones? PYY? Ghrelin?
  - Protein Leverage? X Leverage?
  - Artificial Flavors, other ingredients, or lack thereof?
  - Role of the Microbiome?

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Key Questions:

- Can ultra-processed foods be reformulated to avoid their effects on calorie intake and weight gain?
  - Perhaps, but we first need to better understand mechanisms
  - Our study suggests that a focus on Salt, Sugar, & Fat may not necessarily be effective
- Is it a feature or a flaw of NOVA that product reformulation can't move an ultra-processed product into another NOVA category?
  - Can't turn a "bad food" into a "good food" by changing its nutrient profile

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Key Questions:

- Policy implications are not necessarily clear
  - Ultra-processed foods are convenient, tasty, inexpensive, and safe from a microbiological perspective
  - Ultra-processed foods contribute a large fraction of habitual dietary calories and nutrients in the USA and elsewhere
  - Preparing meals from unprocessed foods and culinary ingredients takes more time, money, skill, and equipment to do safely and effectively
  - A tax on ultra-processed foods would likely be regressive and disproportionately affect those in lower SES

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Intramural NIH

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Volunteer Study Subjects

one program
many people
infinite possibilities

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Diet Preparation

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one program
many people
infinite possibilities

World Nutrition Volume 7, Number 1-3, January-March 2016

The Food System

Food classification. Public health
NOVA. The star shines bright

Carlos A. Monteiro, Geoffrey Cannon, Renata Levy, Jean-Claude Moubarac, Patricia Jaime, Ana Paula Martins, Daniela Canella, Maria Louzada, Diana Parra. Also with Camila Ricardo, Giovanna Calixto, Priscila Machado, Carla Martins, Euridice Martinez, Larissa Baraldi, Josefa Garzillo, Isabela Sattamini. Centre for Epidemiological Studies in Health and Nutrition, School of Public Health, University of São Paulo, Brazil
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NOVA Classification System

- Classifies foods into 4 groups
  - Unprocessed or Minimally Processed
  - Processed Culinary Ingredients
  - Processed Foods
  - Ultra-Processed Foods

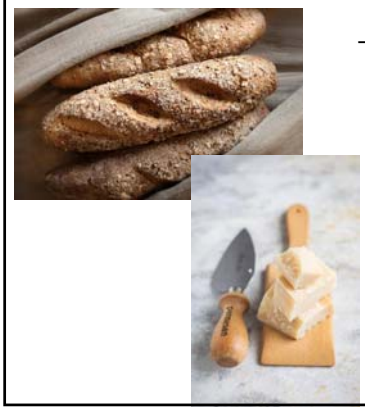
NOVA Classification System

- Unprocessed or Minimally Processed Foods
  - Fresh, dry or frozen fruits or vegetables
  - Grains
  - Legumes
  - Meat
  - Fish
  - Milk

NOVA Classification System

- Processed Culinary Ingredients
  - Table sugar
  - Oils
  - Fats
  - Salt
  - Other substances extracted from foods or from nature, and used in kitchens to make culinary preparations

NOVA Classification System



- Processed foods
  - Foods manufactured with the addition of salt or sugar or other substances of culinary use to unprocessed or minimally processed foods, such as canned food and simple breads and cheese

NOVA Classification System

- Ultra-processed Foods
  - formulations of several ingredients which, besides salt, sugar, oils and fats, include food substances not used in culinary preparations, in particular, flavors, colors, sweeteners, emulsifiers and other additives used to imitate sensorial qualities of unprocessed or minimally processed foods and their culinary preparations or to disguise undesirable qualities of the final product

CREATING THE DIETS

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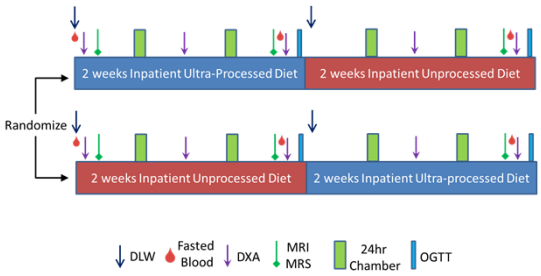


- 7-day rotating menu
- 2 weeks on each diet
- Base menus 150% of energy needs
- Snacks 50% of total energy needs

Energy and nutrients

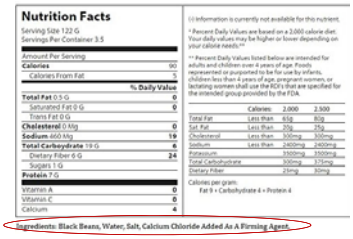
- Energy
  - Twice the basal metabolic rate with activity factor of 1.6
- Nutrients controlled
  - Carbohydrate (50±5%)
  - Fat (35±5%)
  - Protein (15±5%)
  - Sodium – matched
  - Total Sugar - matched
  - Total Fiber - matched

Food sourcing

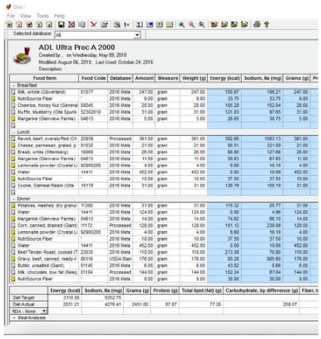
- Available with main supplier
- Had food codes that were available in USDA and FNDDS databases or NDSR

Food Code	Amount (g)	Energy (kcal)	Fat (g)	Carbohydrate (g)	Protein (g)
Kronos Brand Label	28	80	7.0	5.0	2.0
16158 (commercial)	28	66	5.0	4.2	2.2
45333687 (generic brand)	28	60	4.5	4.0	2.0
45210067 (Sabra)	28	74	5.4	4.4	2.0

Food labels



Diet Design



Calculated to gram weights in specialized nutrition software
(ProNutra, Viocare, Inc)

Foods measured to the tenth of a gram by metabolic cooks

Testing

Base Diets

- ☑ Energy at 2000 kcal for the week
- ❑ Nutrients
  - ☑ Carbohydrate
  - ☑ Fat
  - ☑ Protein
  - ❑ Sodium – matched
  - ❑ Total Sugar – matched
  - ❑ Total Fiber - matched

Base Diets

- Nutrients naturally higher in ultra-processed foods

- Nutrients naturally higher in unprocessed foods
  - Fiber

Additional Challenges

VS

Picture by Jennifer Rymaruk/NIDDK

Snacks

- Unable to refrigerate snacks
  - Non-perishable
- Bins to hold food, water and waste
- Easily transportable
- Daily inventory

Patient Recruitment

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Participant Recruitment and Screening

- Recruitment office
- Research nurse calls patient for phone screening
  - Reviews any food allergies, intolerances or disliking of specific foods
- Patient comes in for "in person" screening visit
- Fills out nutrition questionnaires
  - DHQIII
  - Food liking questionnaire
- Test tray and menu of all foods for each two week rotation

Participant Recruitment and Screening

Food Processing Study (18-DK-0044)
FOOD SELECTION QUESTIONNAIRE

INITIALS_____ DATE_____

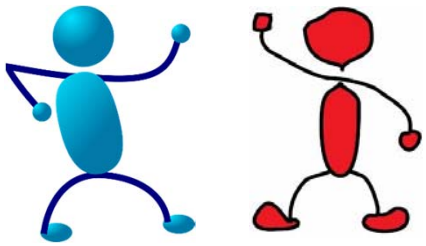
Please rate how much you like each of the following foods by putting a check mark in the column that best describes your feelings. Note that 1=dislike extremely, 5=neutral (neither like nor dislike), 9=like extremely. Any column may be used.

		Dislike				Neutral				Love
	Never Tasted	1	2	3	4	5	6	7	8	9
Pancakes										
Margarine										
Syrup										
Turkey Sausage										
Tater Tots										
Apple Juice										
White Bread										
Turkey Breast										
American Cheese										
Mayonnaise										
Baked Potato Chips										

Logistical Challenges and Nuances

- Menu creation:
  - Constraints on food supply/ingredients – try to limit the amount of items to those already purchased by the main hospital kitchen
  - Staffing
    - Cook weekend hours – cold dinners for quality
- Metabolic Chamber
  - menu must be kept same for both visits
  - ad libitum snacks
- Lack of refrigerators in patient rooms for snacks

Consistency between participants



Ultra-processed vs Unprocessed Diets

The meals had similar amounts of:
Calories, Carbs, Fat, Protein, Sugar, Sodium, Fiber

20 Adults were instructed to eat as much or as little as desired

Primary Outcome: Energy Intake Differences

KD Hall et al. *Cell Metabolism* 30:1-11 (2019).

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Reformulation of Diets for New Study

- Many comments from people who read the paper
  - Energy density of non-beverage foods
  - Small protein difference (<1%)
  - Visual appearance, palatability, eating rate
  - Ultra-processed diet was not similar enough to the unprocessed diet
  - Snacks very different
  - Fiber matched but very different types of fiber
  - Total fat matched but type different

Thanks to everyone that made this happen!

Metabolic Dietitians
Shanna Yang
Sara Turner
Merel Kozlosky

Metabolic Cooks
Waters
Jeff
Joshua

Metabolic Health Technicians
Klaudia Raisinger
Cari Ardrey
Kelly Pauly

Dr. Hall for all of his great ideas and support!

The Hall research team.

All the participants that make this happen.

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many people
infinite possibilities

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Practice Applications

- A diet high in ultra-processed foods promotes increased calorie intake and weight gain
- The mechanisms responsible for why ultra-processed food leads to excess calorie intake are uncertain, but likely involves factors beyond nutrient composition
- More research is required to better understand the mechanisms whereby ultra-processed foods promote excess calorie intake and whether such foods can be reformulated to mitigate these effects

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