

Protein:

Appetite Control & Weight Management



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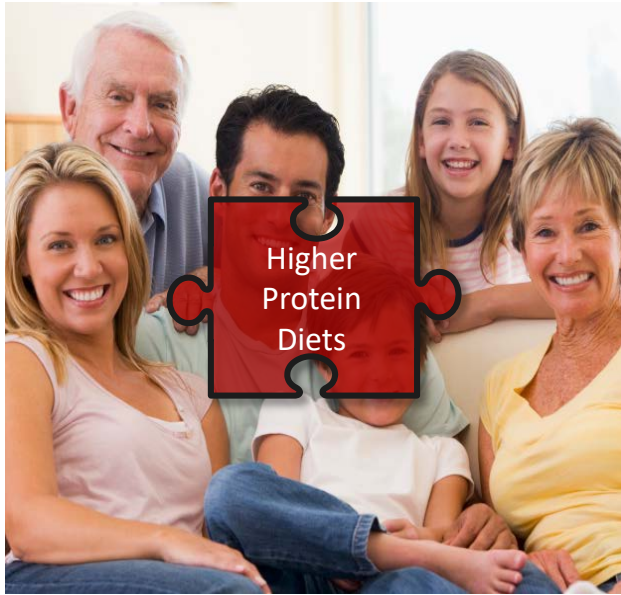
Purdue University

Disclosures

| <i>AFFILIATION/FINANCIAL INTERESTS</i> | <i>CORPORATE ORGANIZATION</i> |
|---|---|
| Grants/Research Support: | The Beef Checkoff |
| Scientific Advisory Board/Consultant: | Egg Nutrition Center Kellogg Milk PEP Medical Advisory Whey Protein Advisory Panel Leprino Foods Sabra |
| Speakers Bureau: | National Cattlemen's Beef Association National Dairy Council |

Assembling the Pieces

Healthy Living



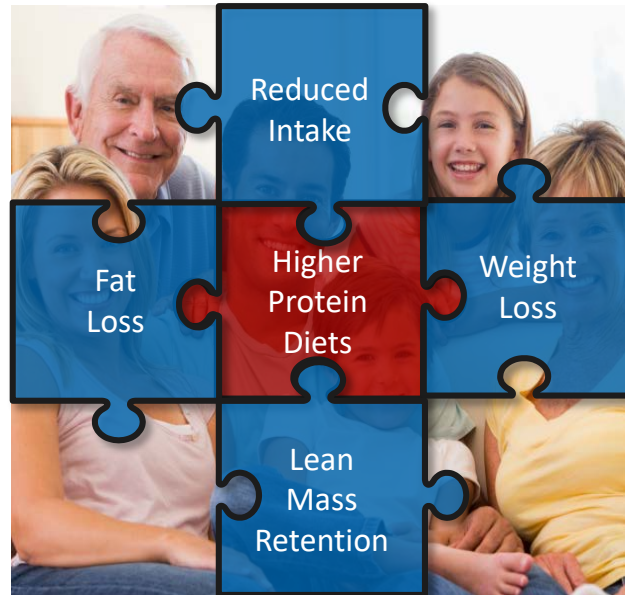
See Review: Leidy HJ et al.; AJCN; Epub; 2015; Apr 29; ajcn084038

Proposed Benefits

- *Improve:*
 - Weight Management
 - Fitness/Performance
- *Reduce risk of:*
 - Sarcopenia
 - Type 2 Diabetes
 - Cardiovascular Disease
 - Obesity
 - Metabolic Syndrome

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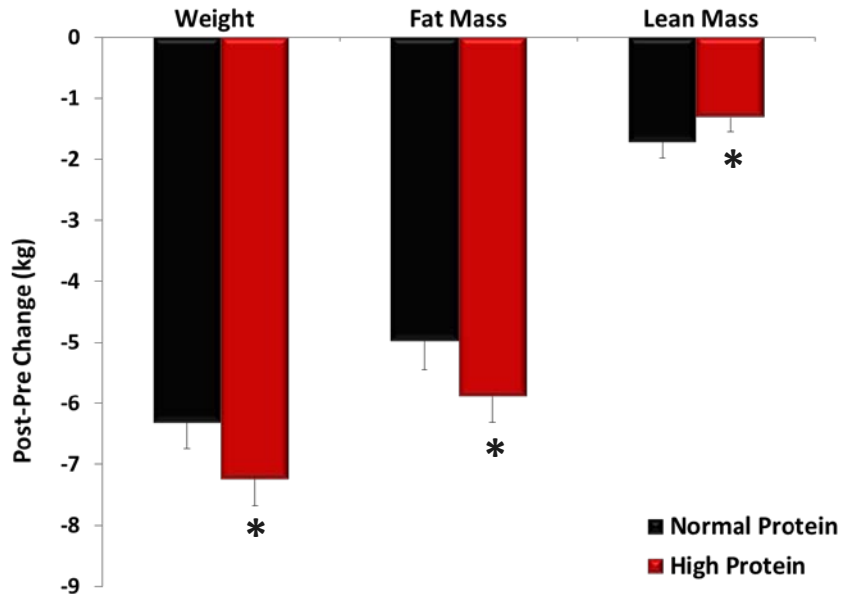
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Higher Protein Diets Promote Weight Management

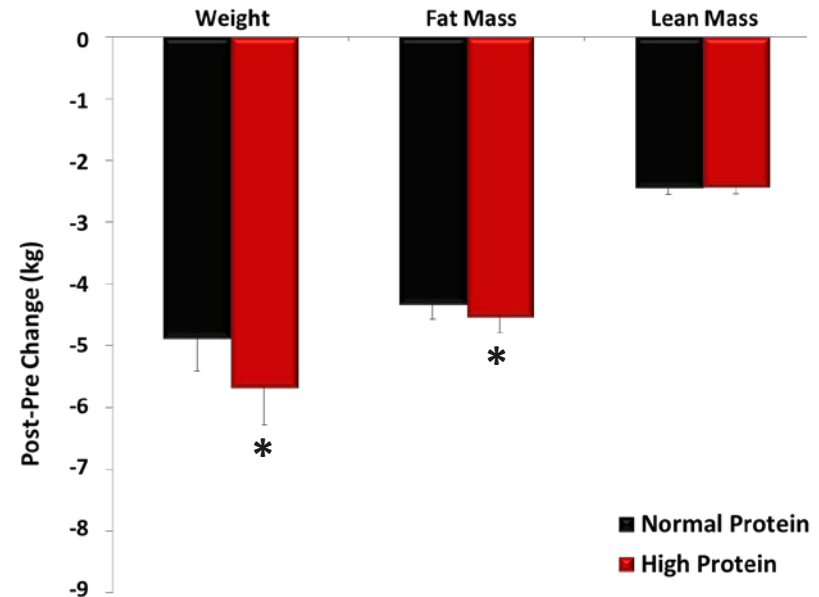
24 weight loss trials of < 1 yr

Normal (18%) vs. High Protein Diets (30%)



32 weight loss trials of > 1 yr

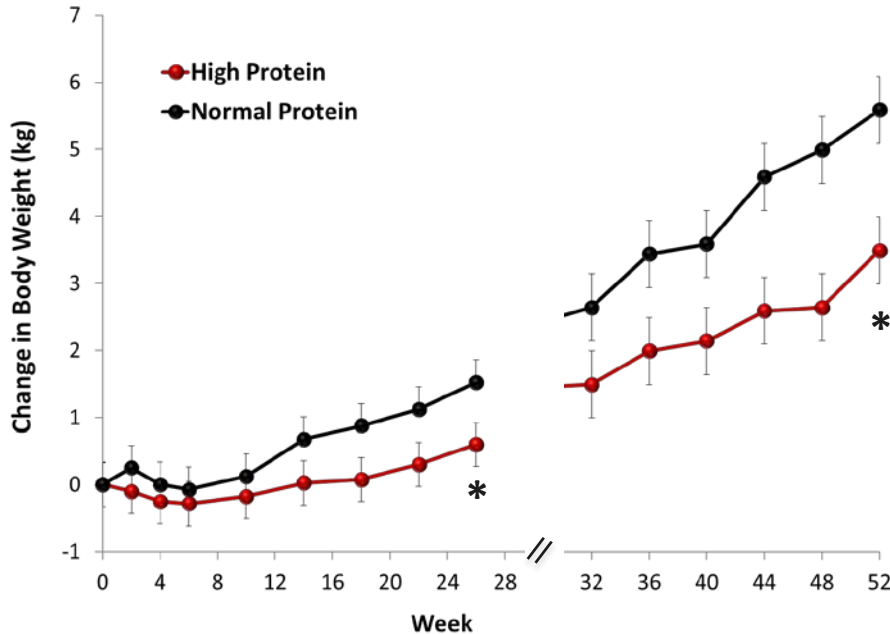
Normal (15%) vs. High Protein Diets (30%)



Higher Protein Diets Promote Weight Management

DioGenes Study – weight maintenance trial following weight loss in ~1,000 adult
Normal Protein (13%) vs. High Protein (22%)

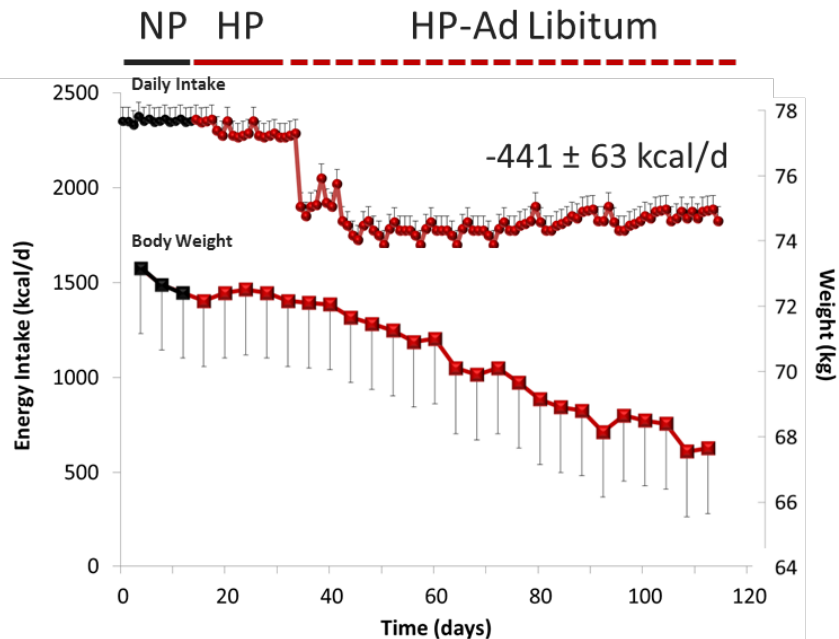
**-11 kg
(8% initial
body wt.)**



**Less fat regain
(-1.6 kg) following
HP vs. NP
($P < 0.05$)**

Higher Protein Diets & Energy Intake

Free-living, Ad Libitum Feeding Trial 30% protein diet with ad libitum energy



Modified from: Weigle et al. 2005 Am J Clin Nutr; 41-48; Leidy HJ et al.; AJCN; 2015 suppl.

Systematic Review of Acute Studies

| First author, year (reference) | Lower Protein Meals (g Pro) | Higher Protein Meals (g Pro) | Subsequent meal energy content, (kcal) |
|--------------------------------|-----------------------------|------------------------------|--|
| Stubbs, 1999 (39) | 66 | 207 | ∅ |
| Stubbs, 1996 (40) | 58 | 185 | ∅ |
| Batterham, 2006 (13) | 46 | 178 | — |
| Brennan, 2012 (41) | 28 | 127 | ↓ (148) |
| Foster-Schubert, 2008 (25) | 13 | 100 | — |
| Belza, 2013 (30) | 24 | 88 | ∅ |
| Barkeling, 1990 (42) | 16 | 64 | ↓ (38) |
| van der Klaauw, 2013 (43) | 20 | 60 | ∅ |
| Boelsma, 2010 (44) | 17 | 59 | ∅ |
| Blom, 2006 (45) | 19 | 57 | ∅ |
| El Khoury, 2010 (46) | 14 | 55 | — |
| Vozzo, 2003 (47) | 25 | 51 | ∅ |
| Leidy, 2010 (48) | 26 | 46 | — |
| Leidy, 2010 (49) | 26 | 46 | ↓ (131) |
| Belza, 2013 (30) | 24 | 44 | ∅ |
| Veldhorst, 2009 (50) | 15 | 38 | ∅ |
| Veldhorst, 2009 (51) | 15 | 38 | ∅ |
| Veldhorst, 2009 (52) | 15 | 38 | ∅ |
| Al Awar, 2005 (53) | 20 | 36 | — |
| Smeets, 2008 (54) | 14 | 35 | — |
| Leidy, 2013 (55) | 13 | 35 | ∅ |
| Leidy, 2007 (29) | 17 | 28 | — |
| Makris, 2011 (56) | 12 | 24 | ∅ |
| Karhunen, 2010 (57) | 3 | 20 | ∅ |

**18% report
reductions in
subsequent
intake**

Higher Protein Diets & Energy Intake

Free-living, 'Semi' Ad Libitum Feeding Trial (set protein amount + CHO & fats ad libitum)
Standard (15%, 15 g/meal) vs. Higher Protein Diets (25%, 30g/meal)

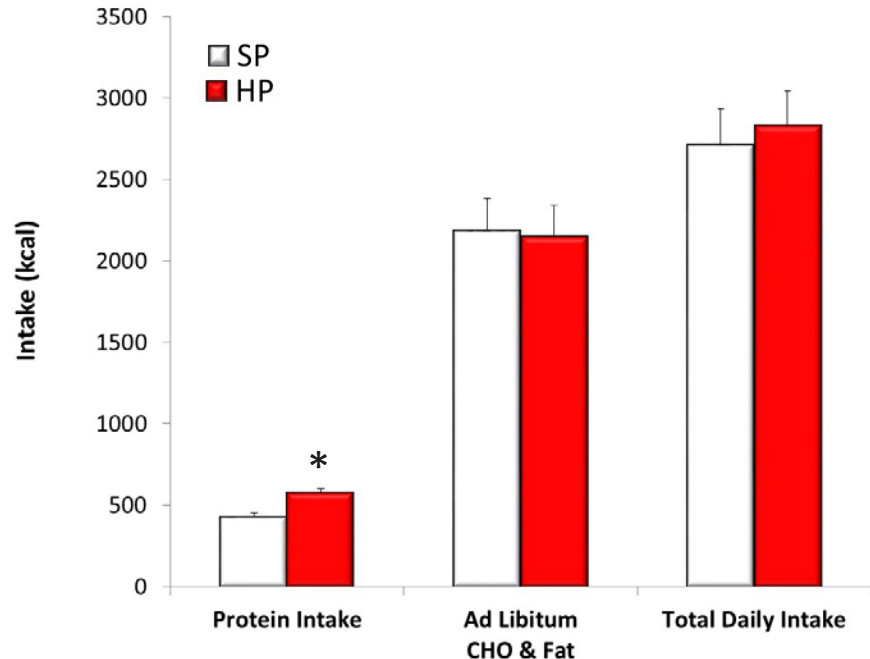
| Menu | | |
|-----------------------------|------------------------------------|---|
| | Required Protein-rich Foods | Ad Libitum Carbohydrate & Fat-rich Foods |
| <u>Breakfast</u> | <i>Scramble</i> | <i>Banana Bread Nutella Grapes</i> |
| <u>Lunch</u> | <i>Sloppy Joe</i> | <i>Rolls Potato Salad M&Ms</i> |
| <u>Dinner</u> | <i>Indonesian Steak</i> | <i>Steamed Vegetables Rice Noodles Peanuts Fudge Brownies</i> |
| <u>Evening Snack</u> | <i>Jerky</i> | <i>Trail Mix (Pretzels, Cashews, Chocolate Morsels, Craisins)</i> |



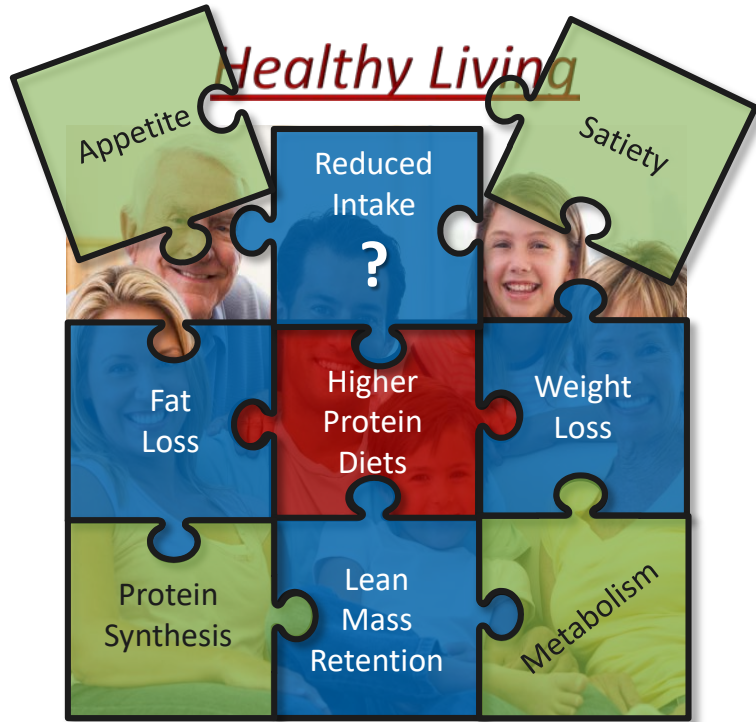
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Assembling the Pieces

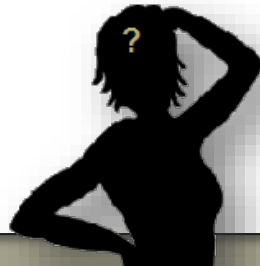


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Proposed Benefits

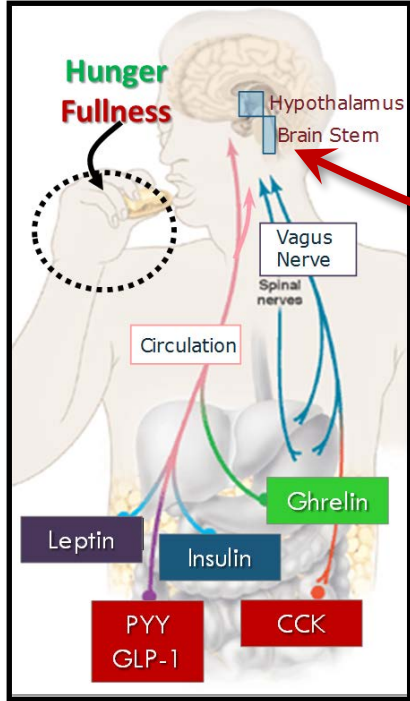
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Eating Behaviors



Eating Behaviors

Perceived Sensations



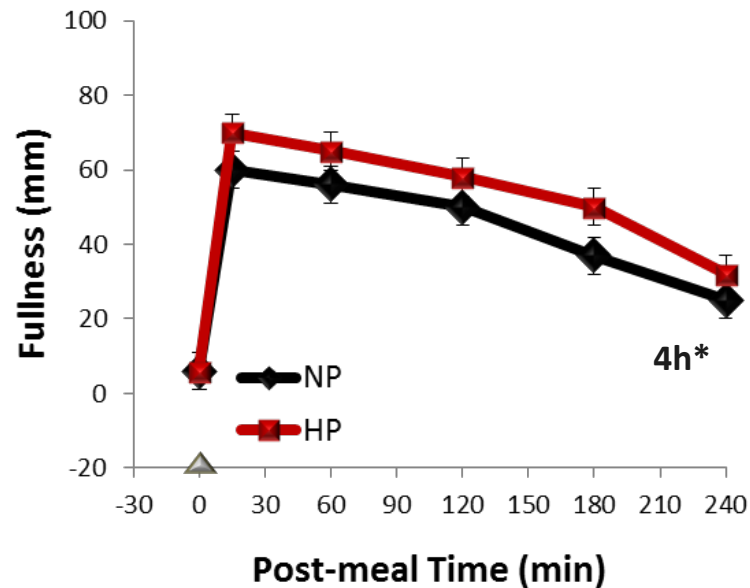
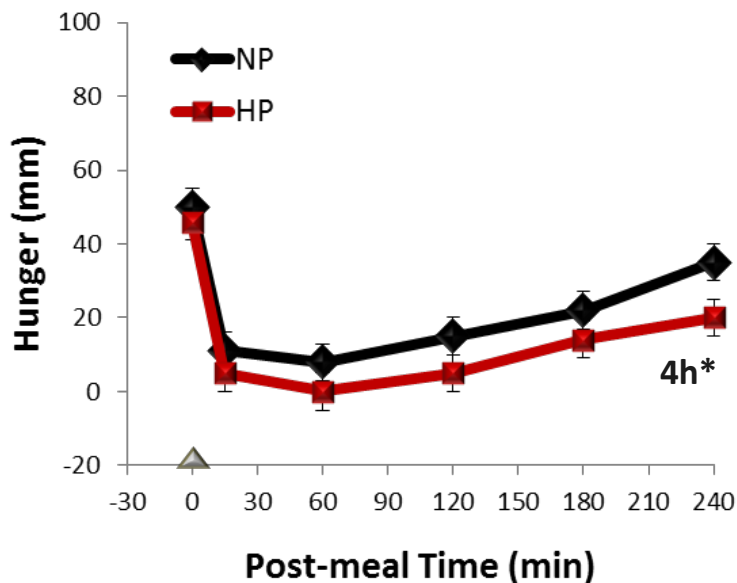
Homeostatic Signals



Reward (Environmental) Stimuli

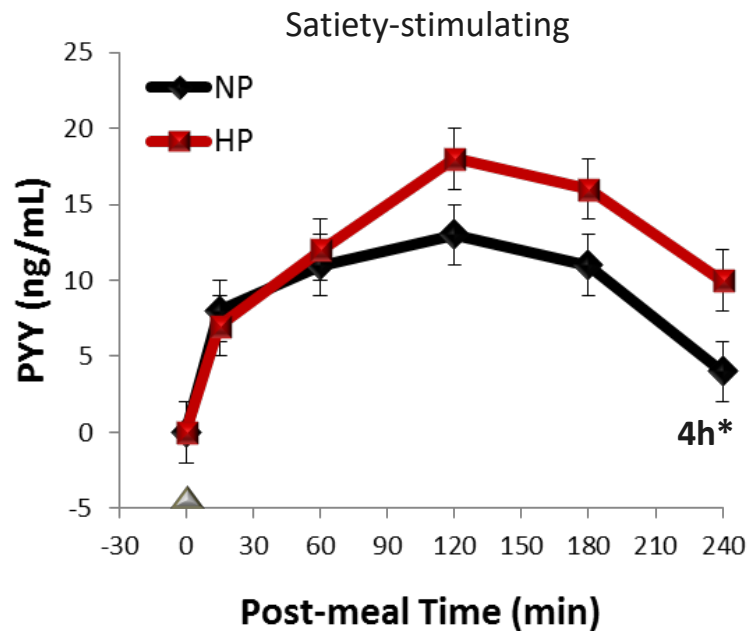
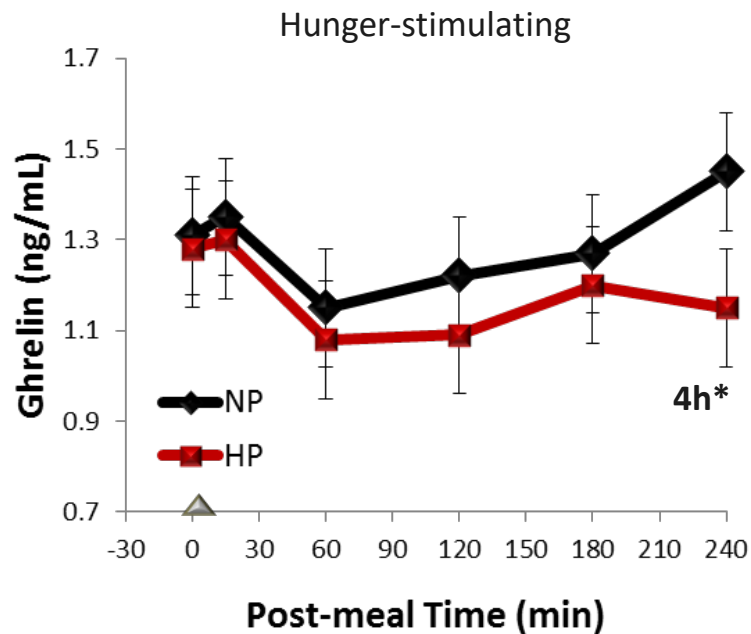
Increased Dietary Protein & Appetite Control/Satiety

Acute meal studies in adults providing meals as
Normal Protein (NP): 13-20 g vs. High Protein (HP): 28-50 g



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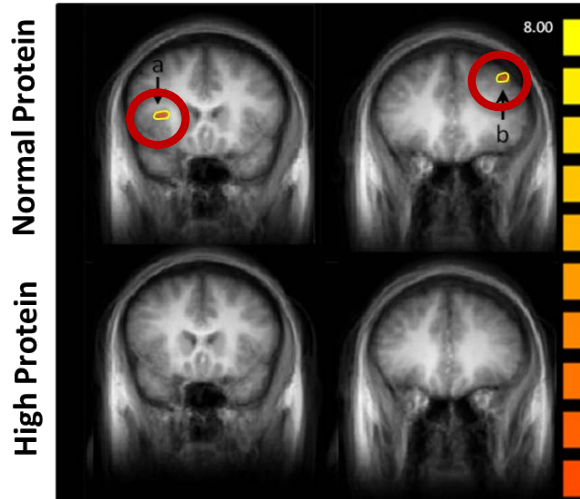
Increased Dietary Protein & Food Cravings/Reward

Acute meal studies in adults providing meals as
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Food Stimuli



Post-meal Activation



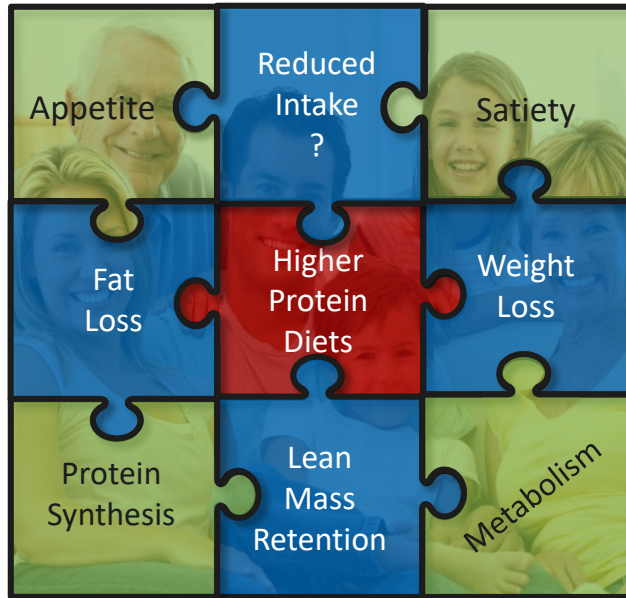
Insula
(food cravings)

Pre-frontal
(executive control)

***Additionally,
Consuming HP meals
tend to reduce perceived
cravings for high fat
foods vs. NP meals**

Assembling the Pieces

Healthy Living

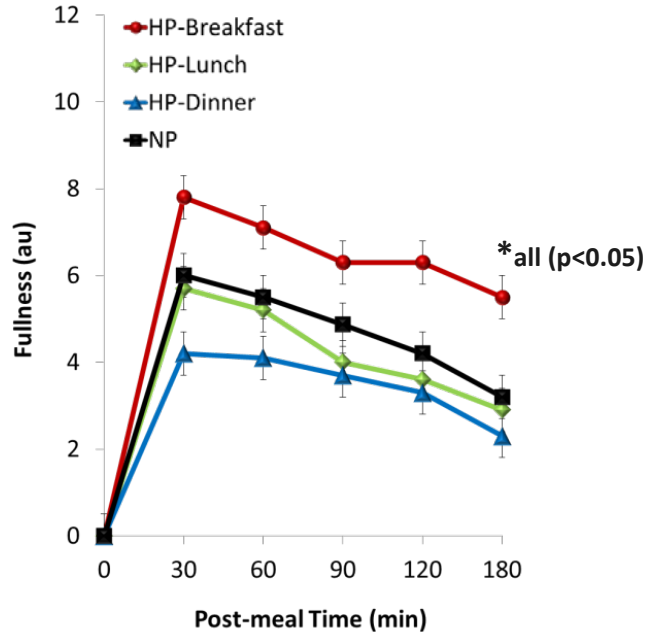


Key
Protein-related
Factors

See Review: Leidy HJ et al.; AJCN; Epub; 2015; Apr 29; ajcn084038

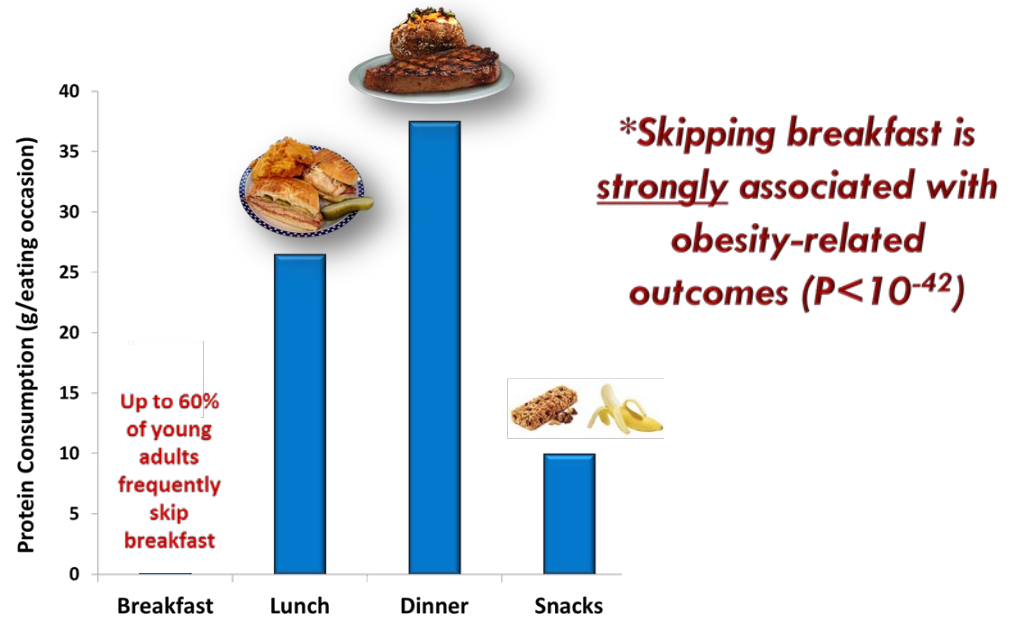
Timing of Protein Consumption-Breakfast

Fullness following high protein breakfast, lunch, vs dinner meals



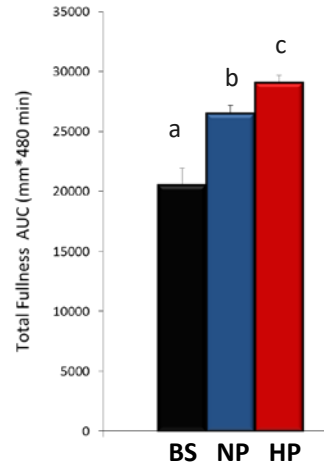
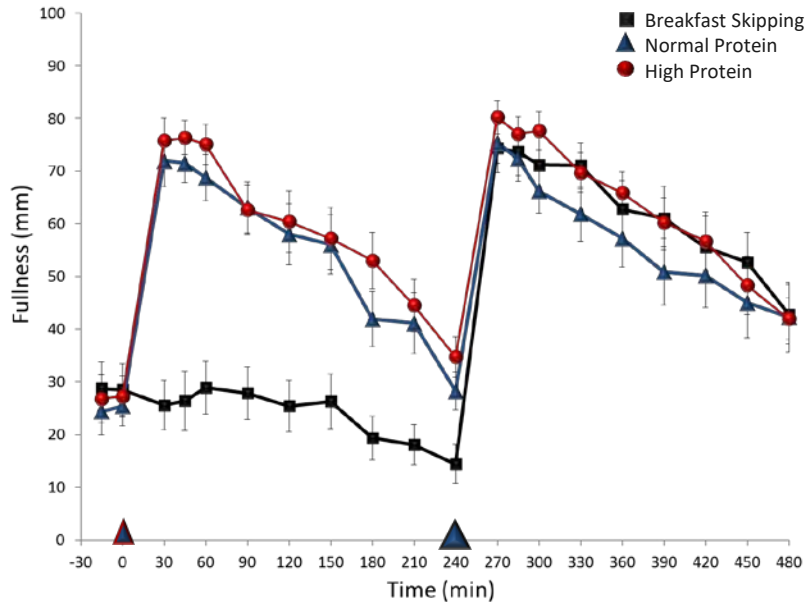
Breakfast Consumption

NHANES Data assess protein distribution



Benefits of a High Protein Breakfast

Acute & Long-term Studies in Overweight 'Breakfast-skipping' Young People 350 kcal Normal (15g Pro) vs. High Protein (30g Pro) Breakfasts vs. Skipping



Compared to BS &/or NP, HP:

↓ Ghrelin (hunger)

↑ PYY (satiety)

↓ Evening brain-activation
(associated with food cravings)

↓ Evening snacking on high
fat/sugar foods

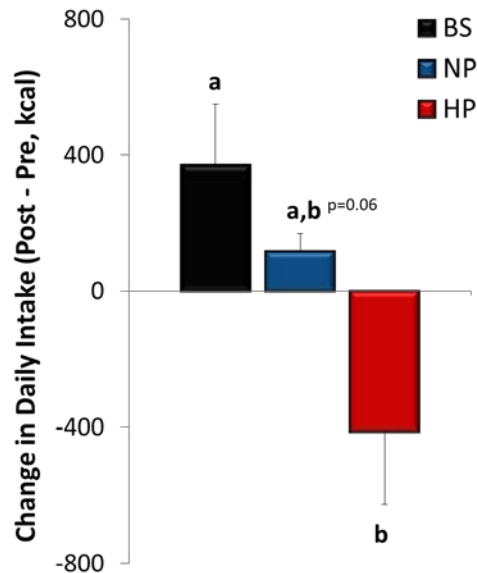


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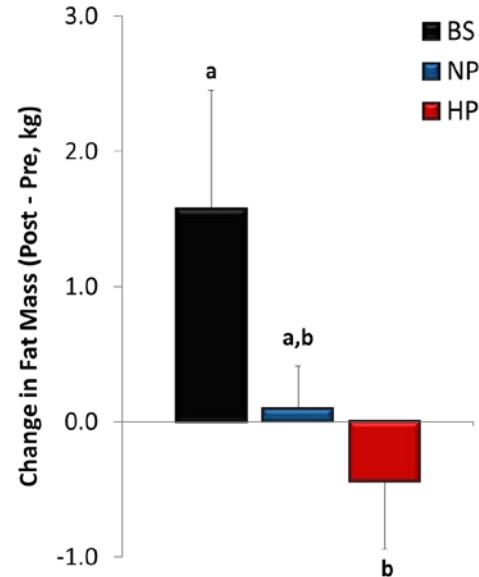
Acute & Long-term Studies in Overweight 'Breakfast-skipping' Young People

350 kcal Normal (15g Pro) vs. High Protein (30g Pro) Breakfasts vs. Skipping

Changes in Daily Intake



Changes in Fat Loss



Summary

- Consuming a diet higher in protein appears to be an optimal strategy to improve body weight management.
- Potential mechanisms include: increased appetite control & satiety along with reducing food cravings.
- Unique benefits surrounding the consumption of a protein-rich breakfast for weight management in 'breakfast skipping' young people



Many Thanks

Co-investigators:

Kevin Maki, PhD

Chief Science Officer
Midwest Center for Metabolic
& Cardiovascular Research

John Thyfault, PhD

Associate Professor
KUMC

Cary Savage, PhD

Professor
Banner Health

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The Pork Checkoff
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Jess Gwin

Adam Zino

Lindsey Bauer

Steve Douglas

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Leryn Reynolds

