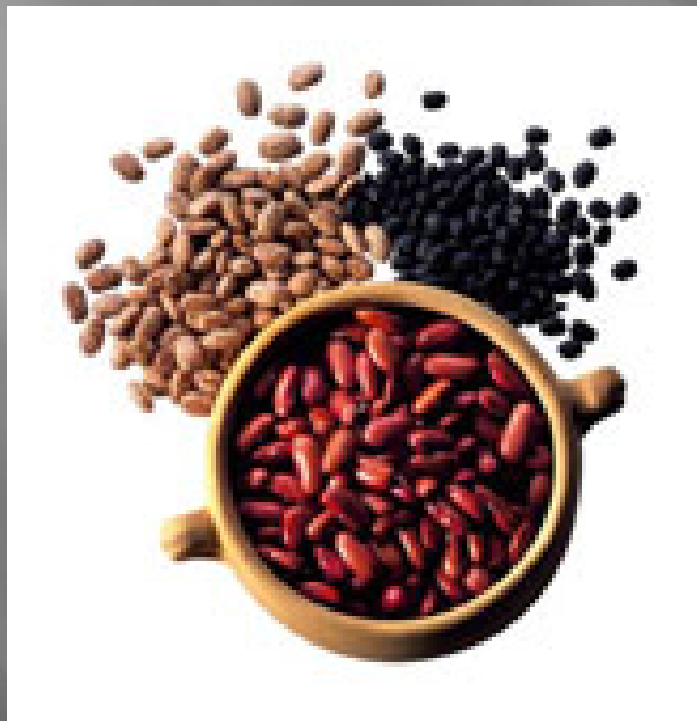


PULSE CONSUMPTION, WEIGHT LOSS SUCCESS, AND CHRONIC DISEASE RISK



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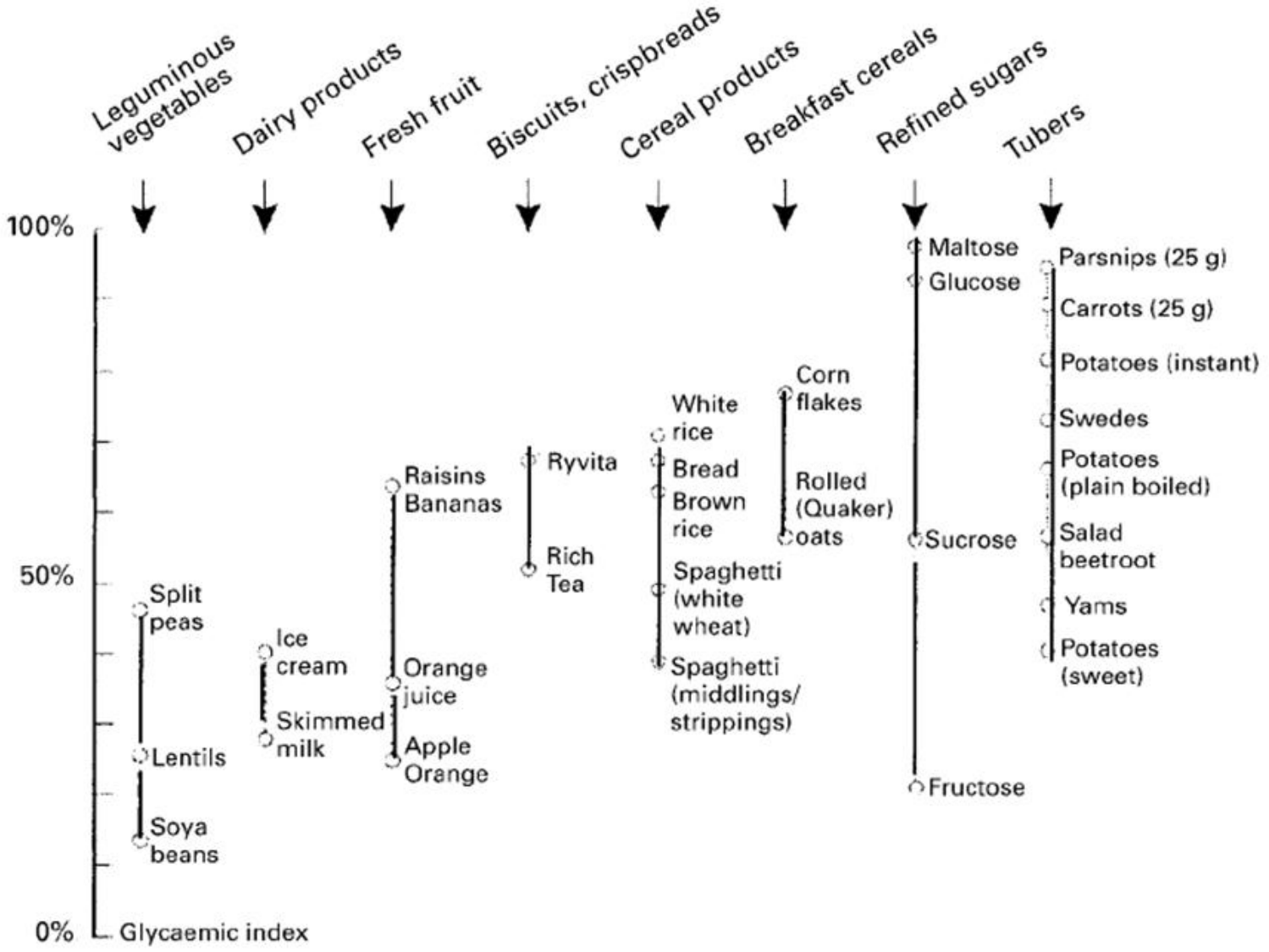
**Ingestive Behavior Research
Center**

Purdue University



**Pulse Health and Food
Symposium 2/5/09**

Glycemic index of several foods and food categories

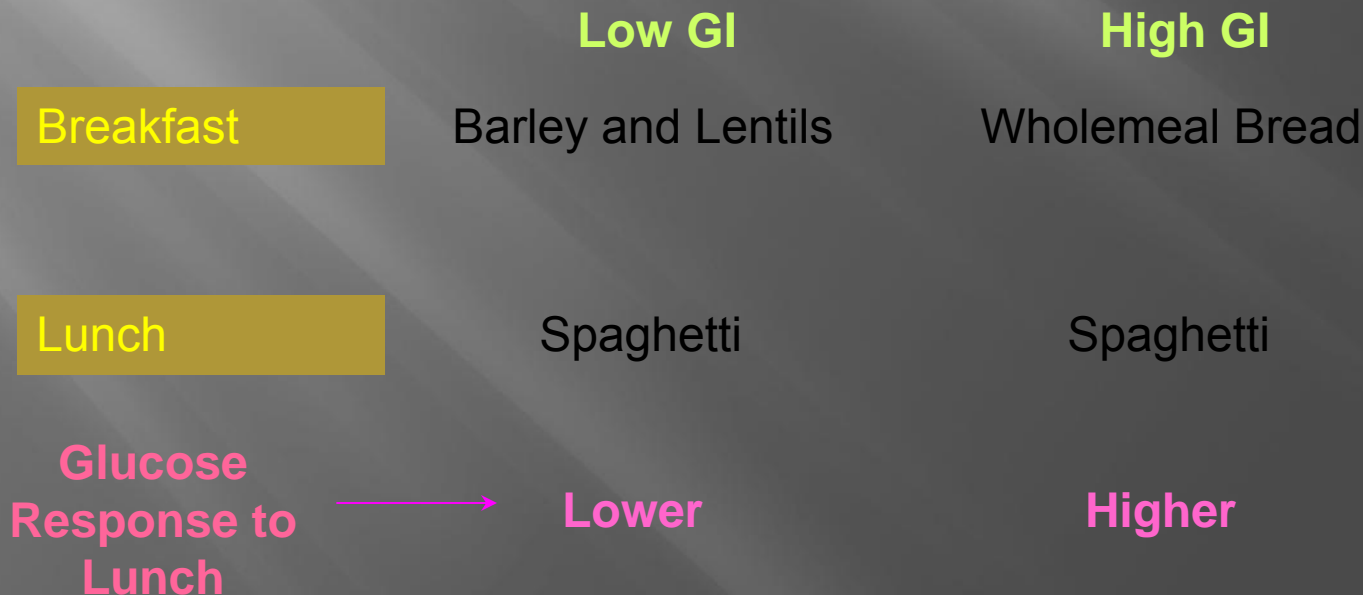


Factors Contributing to Slow Digestibility of Pulses

- ▣ High in fiber (avg ~7 g per half-cup serving). Recommended intake of fiber is 30 g/day for men and 25 g/day for women up to age 50 years (Dietary Reference Intakes, IOM 2002).
- ▣ Viscous soluble fiber
- ▣ High amylose starch
- ▣ Protein (25% energy) -Protein slows starch digestibility when bound to starch
- ▣ “Antinutrients” -Enzyme inhibitors (e.g. amylase inhibitor, trypsin inhibitor)
- ▣ Low Glycemic Index - 45% lower glucose response to pulse consumption vs. other carbohydrate-containing foods (Jenkins et al 1980).

Second Meal Effect of Pulses

- Definition: A reduced glycemic response occurs to a second meal after consuming a first meal that is low in GI



Colonic Fermentation, Pulses and Satiety

- ▣ Fermentable fiber and amylose fermented in the colon produces short-chain fatty acids (SCFA) that can be oxidized and used for energy in preference to glucose (Wolever et al 1989)
- ▣ SCFA may also suppress glucose production in the liver
- ▣ These would produce more stable blood glucose patterns over time, which is hypothesized to result in lowered appetite and energy intake (Mayer 1953; Flatt 1987)
- ▣ Consumption of bread prepared with the SCFA propionate has been linked with increased satiety (Liljeberg et al 1995)

Studies on Beans and Body Weight (1)

Observational

- ▣ **Analysis of dietary data from NHANES 1999-2002 data show in >8000 adults, the odds of being obese was significantly lower in n=915 “bean consumers” compared to n=7314 “non-bean consumers” (OR = 0.78; CI, 0.64-0.97;p=0.026)**

Studies on Pulses and Body Weight (2)

Experimental

- ▣ An 1800 kcal/day provided diet containing rice and beans resulted in greater weight loss compared to a lean meat diet after 1 month (2.4 vs 0.9 kg at one month; $p=0.04$) but at two months the difference was not significant (3.8 vs 1.5 kg; $p=0.10$).
- ▣ Could be due to high dropout rate (35% in rice and bean, 45% in lean meat group)

**Long-term studies on the effects of
beans (legumes) on body weight
regulation are lacking**

The BE WELL Study

The BEans, WEight Loss, and Lifestyle Study

Principal Investigator: Megan A. McCrory, PhD
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Ian T. Kavanaugh, MS

Effectiveness of Two Levels of Pulse Consumption on Caloric Restriction Adherence and Chronic Disease Risk

Funded by Pulse Canada

Basic Design

Baseline

Phase 1 (Intervention)

Phase 2 (Follow-up)



- Randomized, controlled trial (RCT)
- Recruit n=66 men and women BMI 25-40 kg/m² aged 21-50 years
- All individuals were counseled to reduce total daily energy intake by 30% (should result in ~1-1.5 lbs/wk weight loss) for 6 weeks
- Randomized to Low, Medium and High pulse consumption groups
- All groups provided with about half their daily target calorie intake in “pulse foods”
- Measurements at baseline, weeks 3, 6, and 12

Intervention Groups

- DG group (medium): the US and Canadian Dietary Guideline (DG) recommendation of 3 cups of pulses a week (0.5 cups a day for 6 days a week)
- DRI group (high): the amount of pulses necessary to meet the US and Canadian Dietary Reference Intake (DRI) of dietary fiber (1.8 cups a day for women and 2.7 cups a day for men, 6 days a week); or
- Control group (low): minimal pulses (0.0625 cups, i.e. 1 Tablespoon, a day for 6 days a week).

Measurements and Hypotheses

Hypothesis	Measurements	Control (Low)	DG (med)	DRI (high)
1 - adherence	Body Weight, Body Fat	↓	↓ ↓	↓ ↓ ↓
2 – hunger, appetite	Hunger, Desire to Eat Ratings (9-point scale)	↓	↓ ↓	↓ ↓ ↓
3 – chronic disease risk	Serum Cholesterol, Triglycerides, Blood Pressure, Waist Circ., Glucose, Insulin, CRP (inflammation)	↓	↓ ↓	↓ ↓ ↓

Measurements and Hypotheses (2)

Hypothesis	Measurements	Control (Low)	DG (med)	DRI (high)
4 – Eating Patterns	Snacking, Eating Frequency, Desserts	↓	↓ ↓	↓ ↓ ↓
	Fruit, Veg, Pulses	↑	↑ ↑	↑ ↑ ↑
5 – Taste Preferences	Taste Ratings and Intake of Pulse Foods vs. other foods	--	↑	↑

Intervention Groups

	Control (low)	DG (med)	DRI (high)
	Men / Women	Men / Women	Men / Women
Total Energy Provided/day (6 d/wk)	1200 / 1000		
# Items/day	4		
# Items with beans/day	1	1	4
Calories/Item	300 / 250		
Bean servings per Item	1 Tbsp	0.5 cup	0.67 / 0.5 cup
Calories from beans per Item	14	115	154 / 115
Fiber per item (grams)	0.9	7	9.5 / 6.25
Total fiber provided per day (grams)	0.9	7	38 / 25

BE WELL Study Foods

- **Everyday foods made with a variety of pulses (eg lentils, chickpeas, kidney beans, black beans, pinto beans, Great Northern beans, pea hull fiber) – not soybeans**
- **Include a variety of flavors and textures**
- **3-week menu rotation; substitutions for items highly disliked**

BE WELL Study Foods

Breakfasts

Apricot Bulgur

Sweet Potato Cakes

Brunch Casserole

Snacks

Chips and Salsa

Corn Muffin

Snack Mix

Thai Dip w/Pita

Fruit & Nut Bar

Peanut Butter Choc Chip Bar

Entrees

Loaf w/ Gravy

Quesadilla

Sausage Veggie Soup (lentil)

Tomato Pasta

Turkey Chili

Veggie Soup (split pea)

Creamy Tomato Soup

Mediterranean Salad

Salsa Rice

Desserts

Brownie

Chocolate Mint Pudding

Vanilla Pudding

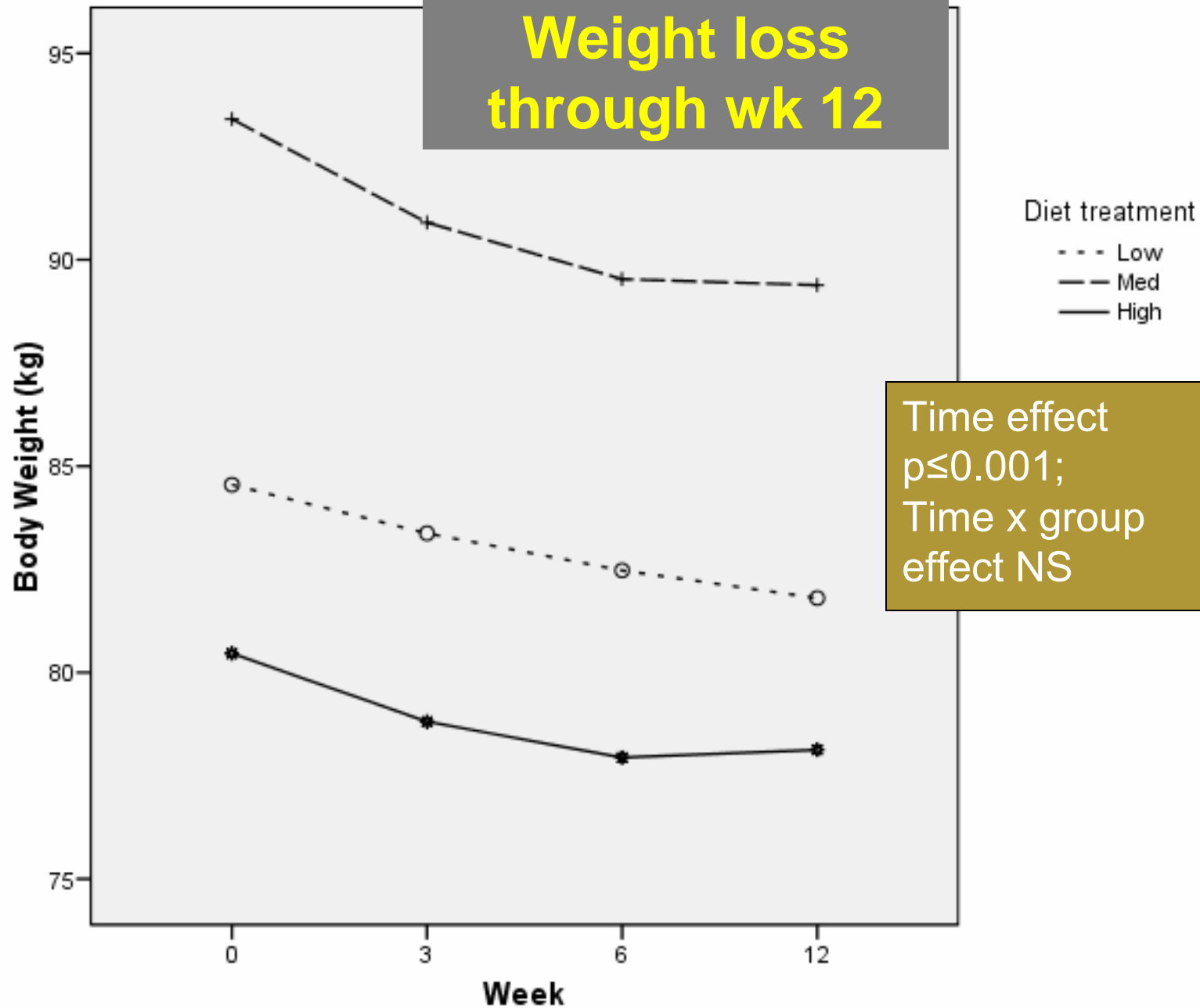
Subjects Characteristics

	Control (Low)	DG (Med)	DRI (High)
	n=13	n=16	n=14
Male (n)	1	3	2
BMI (kg/m ²) at screening	31.1±3.8	32.2±5.2	29.5±3.2
% subjects overweight/obese	46 / 54	38/ 63	57 / 43
Waist circumference (cm)	93.5±8.8	95.1±14.6	90.1±5.7
% subjects above NHLBI abdominal obesity cut-off for chronic disease risk	62	63	43
Age (yr)	40.3±6.8	37.6±6.5	40.8±7.2
Physical Activity Level (PAL)	1.49±0.15	1.45±0.09	1.42±0.06

Body Weight and Composition Changes

	Control (Low)	DG (Medium)	DRI (High)	Repeated Measures ANOVA	
				Time	Time x Group
Δ Body weight (kg)				≤ 0.001	0.050
wk 0-3	-1.0 ± 0.3^a	-2.5 ± 0.4^b	-1.6 ± 0.3^{ab}		
wk 4-6	-0.8 ± 0.3	-1.4 ± 0.3	-0.8 ± 0.3		
wk 0-6	-1.8 ± 0.5^a	-3.9 ± 0.6^b	-2.4 ± 0.7^{ab}		
Δ % Body fat					
wk 0-6	-1.1 ± 0.7	-1.1 ± 0.5	-1.4 ± 0.6	≤ 0.001	NS

Weight loss through wk 12



Subjective Ratings

9-point scale

Assessed using daily logs

1

2

3

4

5

6

7

8

9

Not at all

Extremely

- Physical and mental well-being
- Appetite and dietary satisfaction

Physical Symptoms

1

2

3

4

5

6

7

8

9

Not at all

Extremely

	Low	Med	High	Time	Group	Time x Group
Constipation	1.5±0.3	1.5±0.2	1.6±0.3	NS	NS	NS
Nausea	1.3±0.1	1.1±0.1	1.3±0.1	NS	NS	NS
Cramping	1.6±0.3	1.5±0.2	1.2±0.2	NS	NS	NS
Bloating	1.8±0.3	1.7±0.2	1.5±0.2	NS	NS	NS

Intestinal gas

1

2

3

4

5

6

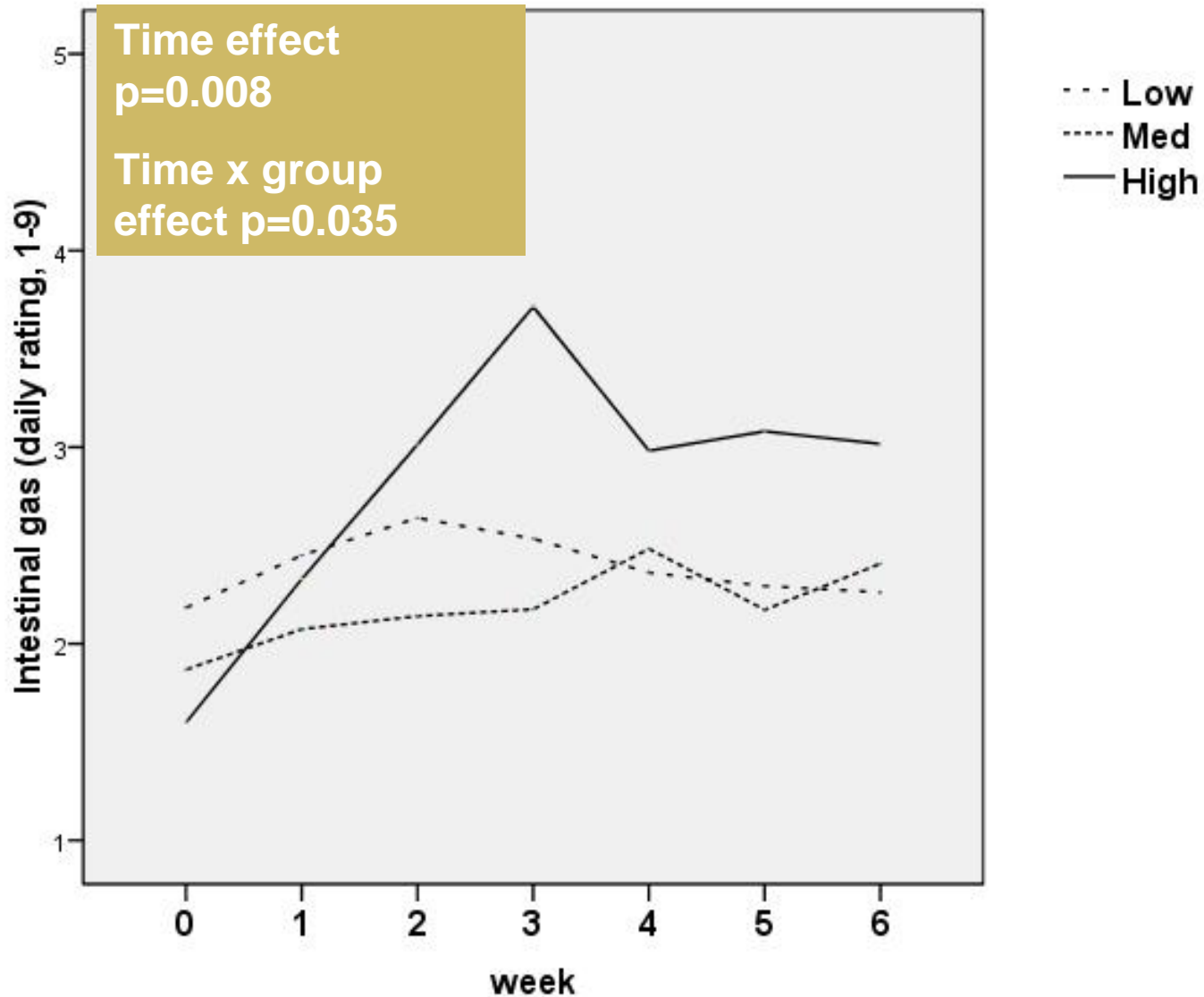
7

8

9

No gas

Extreme
gas



Physical Symptoms

“Number of bowel movements today _____”

	Low	Med	High	Time	Group	Time x Group
				NS	0.034	NS
Number of bowel movements						
Weeks -1to 0	1.9±0.2	1.4±0.2	1.4±0.1			
Weeks 1-3	2.1±0.2	1.3±0.2	1.6±0.2			
Weeks 4-6	2.0±0.3	1.3±0.2	1.8±0.2			

Level of hunger for the day

1

2

3

4

5

6

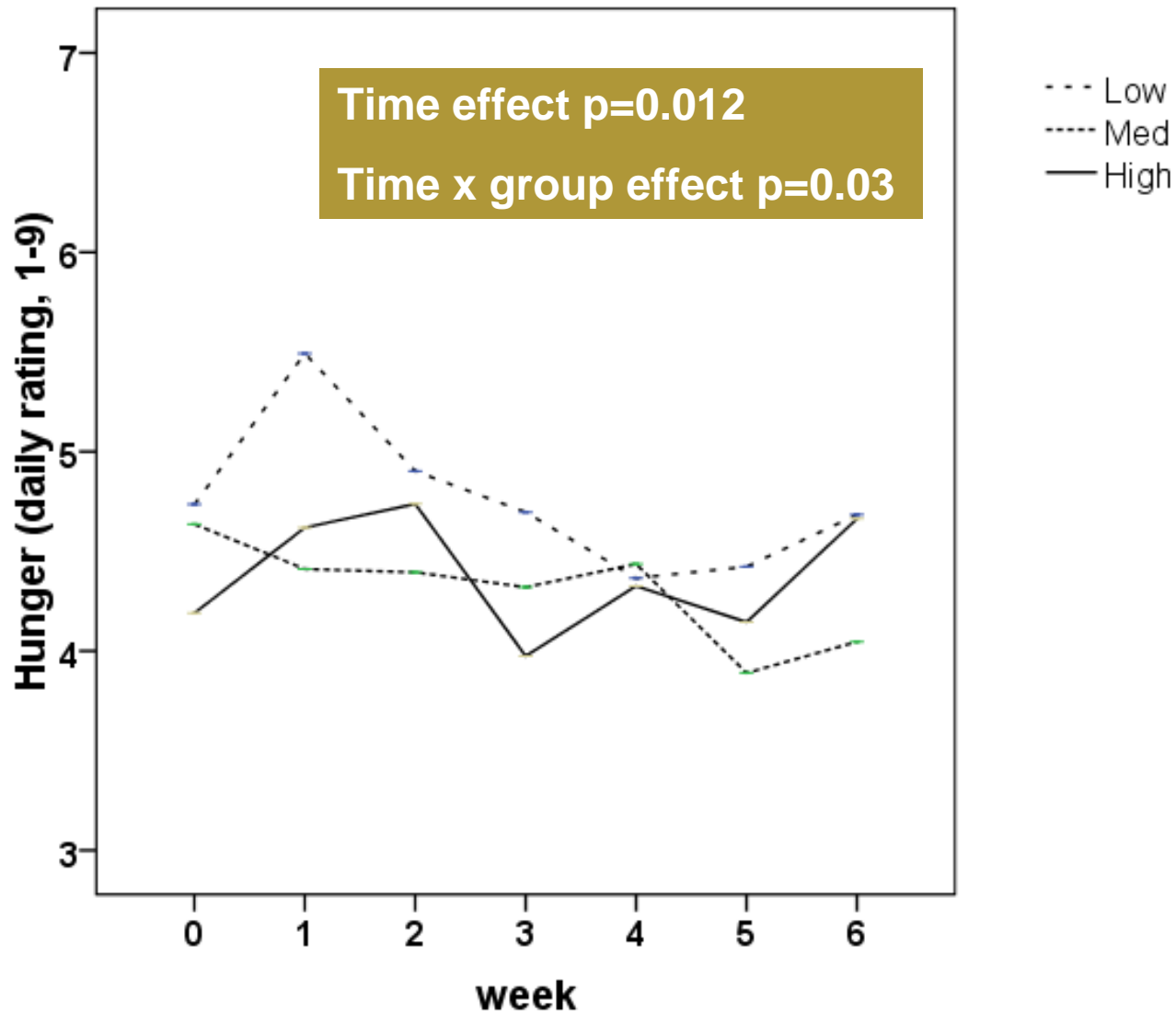
7

8

9

Not at all hungry

Extremely hungry



Dietary Satisfaction

1 2 3 4 5 6 7 8 9

Not at all

Extremely

	Low	Med	High	Time	Group	Time x Group
Satisfied with amount of food eaten/provided	6.7±0.4	6.4±0.2	6.3±0.3	NS	NS	NS
Satisfied with type of food eaten/provided				NS	NS	NS (0.09)
Weeks -1to 0 (eaten)	6.5±0.5	6.1±0.4	5.9±0.4			
Weeks 1-3 (provided)	6.1±0.4	6.4±0.3	6.2±0.3			
Weeks 4-6 (provided)	6.5±0.5	5.9±0.3	6.4±0.4			

Dietary Satisfaction

	Low	Med	High	Time	Group	Time x Group
Desire for sweet foods				0.008	NS	NS
Weeks -1to 0	4.6±0.6	3.5±0.5	4.1±0.5			
Weeks 1-3	3.8±0.7	2.8±0.5	3.4±0.6			
Weeks 4-6	3.2±0.7	2.6±0.5	3.4±0.6			
Desire for savory foods				0.034	NS	NS (0.11)
Weeks -1to 0	4.0±0.6	2.3±0.4	3.1±0.5			
Weeks 1-3	3.5±0.6	2.3±0.5	2.9±0.5			
Weeks 4-6	2.4±0.6	2.2±0.4	3.0±0.5			

Desire to eat foods not....

1

2

3

4

5

6

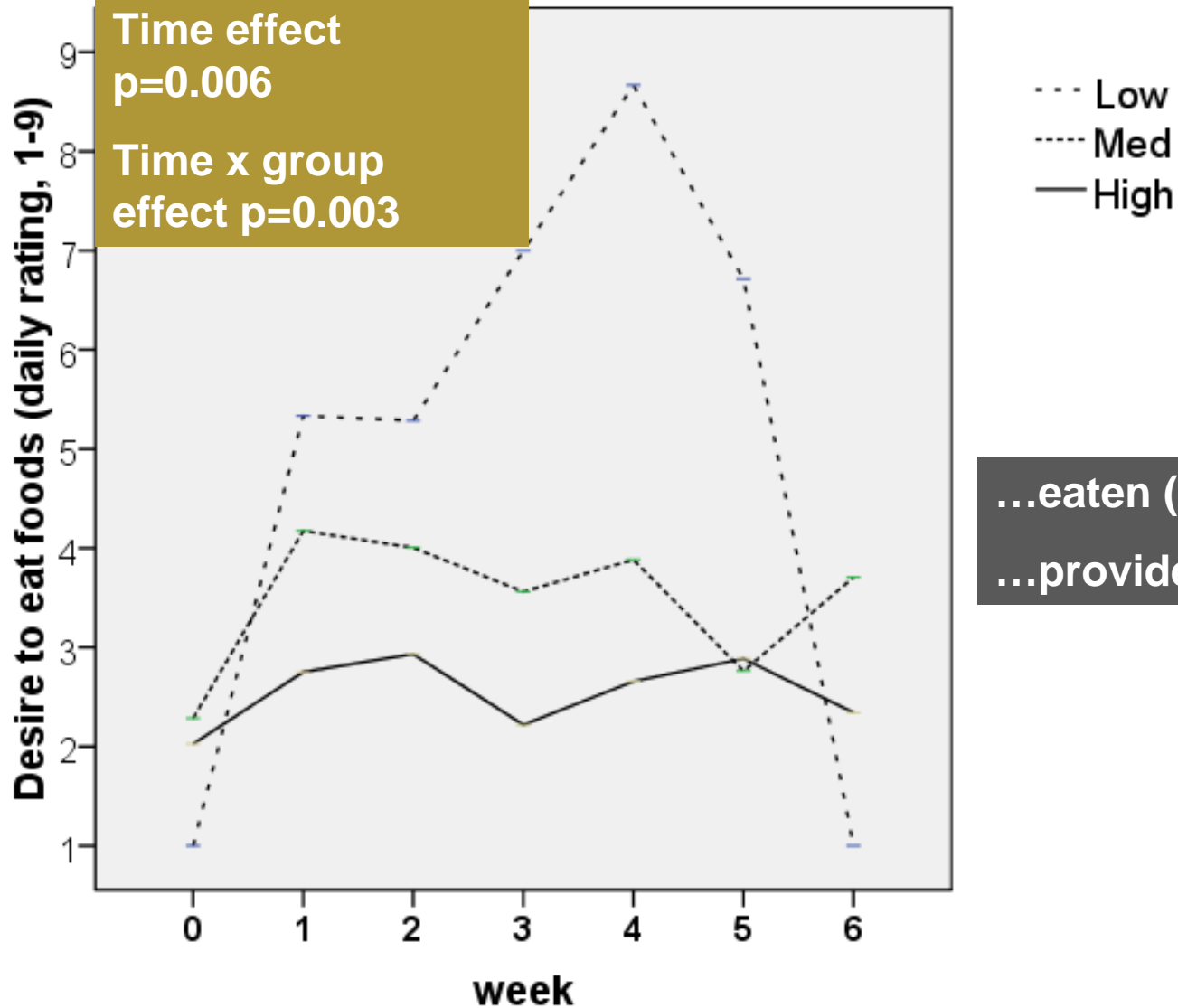
7

8

9

No desire

Extreme
desire



Palatability

Assessed by taste testing in a controlled setting

- tasting booths, subjects cannot see each other
- standardized time
- fork-sized bite of food rated for taste, texture, odor, appearance
- rinse between foods
- standardize time between foods

- Pulse foods vs non-pulse foods
- Study foods vs non-study foods
- Each included entrée, snack, dessert, fruit/veg

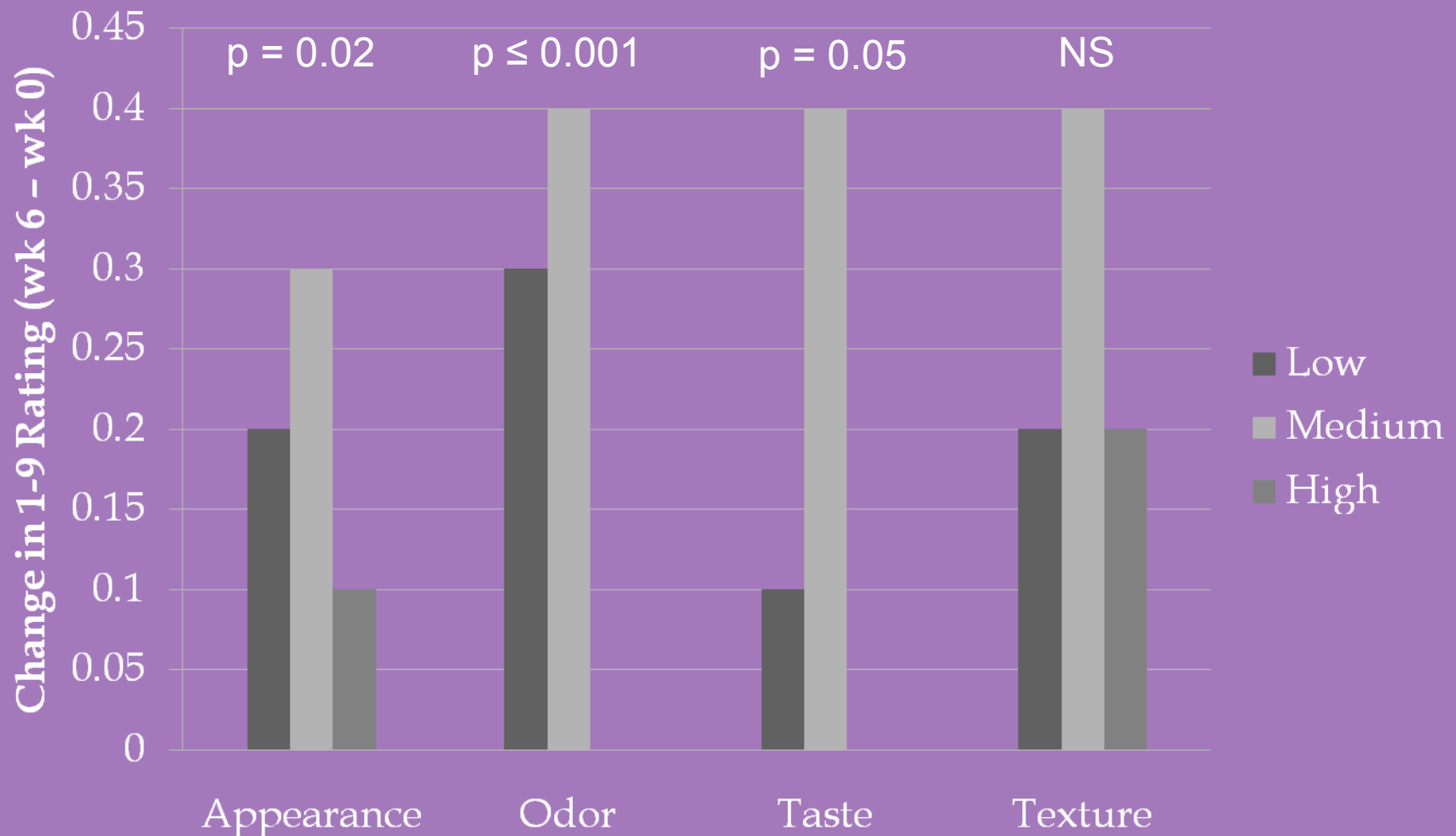
Palatability Results – Repeated Measures ANOVA

	Appearance	Taste	Odor	Texture
Time	0.001	0.002	0.000	0.000
Group	NS	NS	NS	NS
Pulse food	NS	NS	NS	NS
Study food	NS	NS	0.086	0.005
Time x group	0.02	≤0.001	0.05	NS
Time x pulse food	NS	NS	NS	NS
Time x study food	NS	NS	0.06	NS
Time x group x pulse food	NS	NS	NS	NS
Time x group x study food	NS	NS	NS	NS
Time x group x study food x pulse food	NS	NS	NS	NS

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Time x pulse food	NS	NS	NS	NS
Time x study food	NS	NS	0.06	NS
Time x group x pulse food	NS	NS	NS	NS
Time x group x study food	NS	NS	NS	NS
Time x group x study food x pulse food	NS	NS	NS	NS

Changes in Palatability



Changes in Chronic Disease Risk

Significant reductions over time (no group differences): HDL, LDL, total cholesterol, C-Reactive Protein

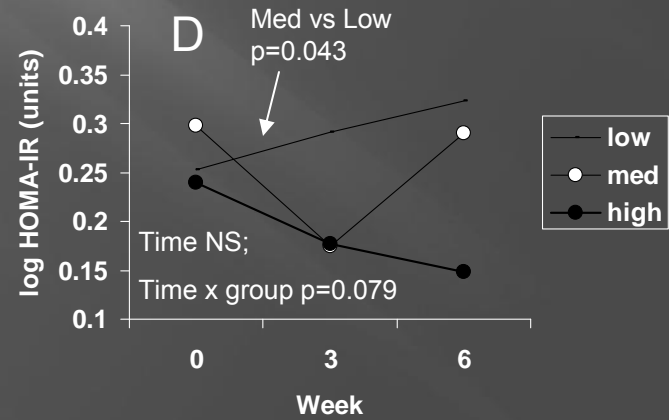
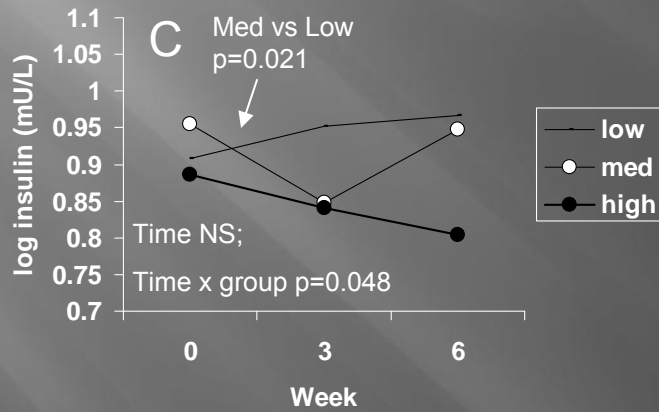
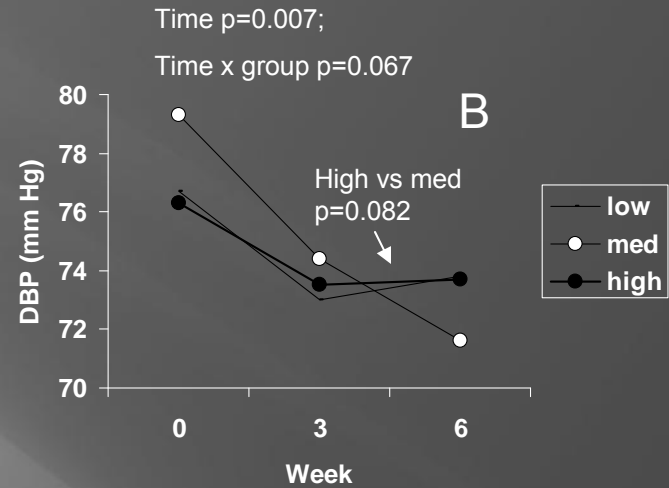
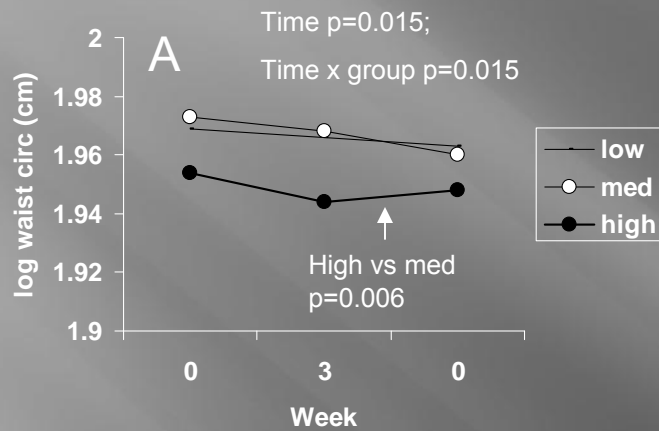
No significant changes over time:

Triglycerides, glucose, systolic blood pressure

Differences among groups in changes over time:

Waist circumference, diastolic blood pressure (DBP), insulin, HOMA-IR (insulin resistance marker)

Changes in Chronic Disease Risk: Group Differences



Summary

- ▣ Consuming at least 0.5 c/day of beans may improve weight loss success and help to reduce chronic disease risk
- ▣ Additional benefits on insulin resistance may occur when consuming more than 0.5 c/day of beans

Future Directions

- ▣ Underlying physiological mechanisms in carefully controlled studies with highly precise and accurate techniques
- ▣ Community studies to encourage consumption of pulses, determining barriers to consumption

Thanks Very Much



BE WELL!