Milk and weight management

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Human obesity: is insufficient calcium/dairy intake part of the problem?

Risk factors for overweight and obesity in adulthood: Results from the Quebec Family Study

Risk factors	Adjusted OR (cross-sectional)	▲ BW (kg) vs reference category (6 y follow-up)
Short sleep duration	3.81*	1.65
High disinhibition eating behavior	3.8*	1.46
Low dietary calcium intake	2.88*	1.3
High susceptibility to hunger behavior	2.2*	1.28
Non-participation in high-intensity physical exercise	2.03*	1.23
High dietary restraint behavior	2.01*	1.09
Non-consumption of multivitamin and dietary supplements	1.86*	0.87
High dietary lipid intake	1.64**	0.61
High alcohol intake	1.37**	0.39

*p < 0.01, ** p < 0.05

Adapted from Chaput et al, Obesity 2009

How can we explain that low dietary calcium intake has a better predictability of overweight than high dietary lipid intake and non-participation in high-intensity physical exercise?

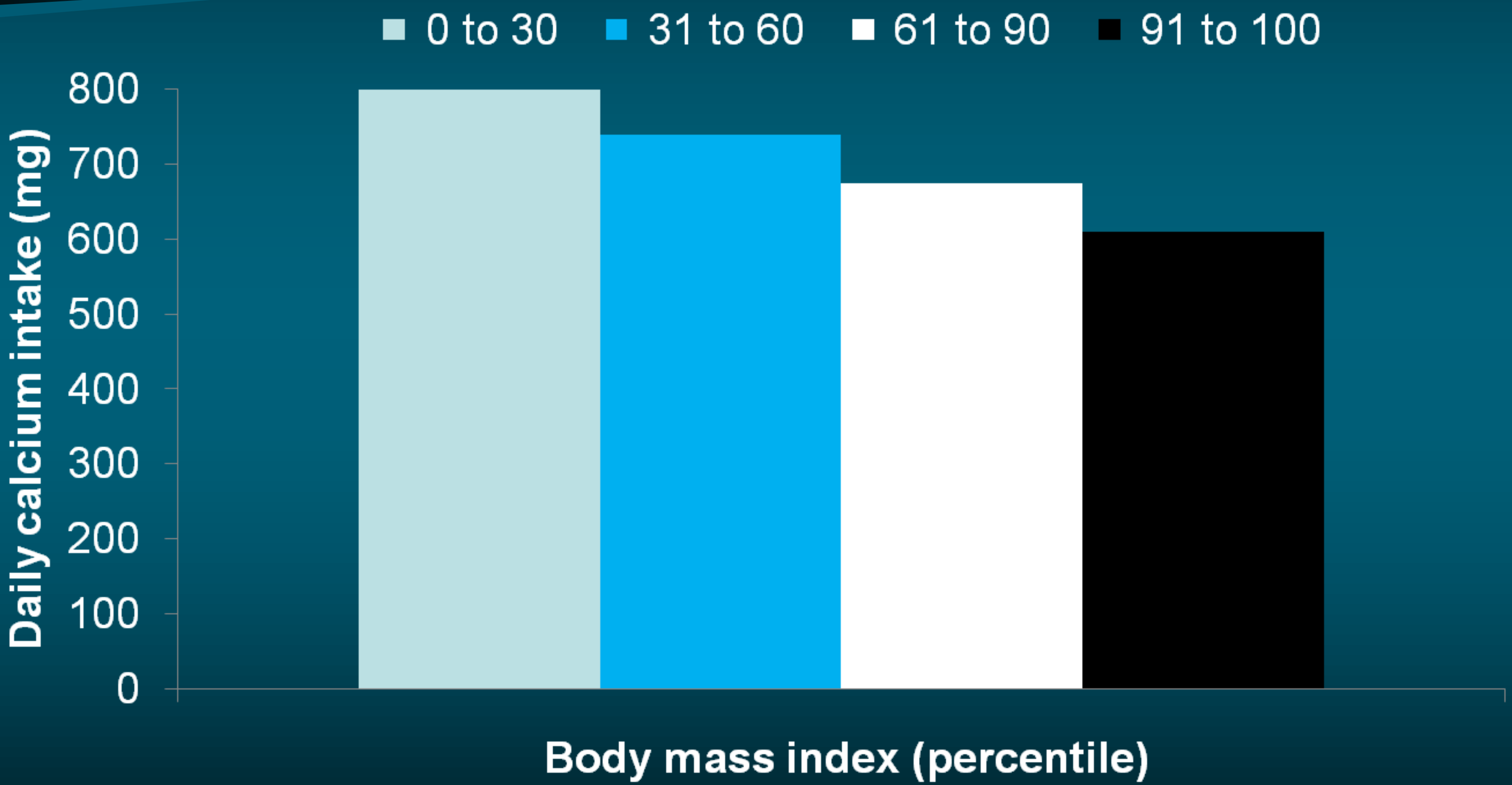
A story that has begun early in the 80s

Dietary calcium in human hypertension

Subjects	Mean calcium intake (mg/day)
Normotensive controls	886
Hypertensives	668

From McCarron DA et al, Science 217:2, 1982

Calcium intake vs. BMI



McCarron DA *et al.* Science 1984;224:1392-8.

2000 :

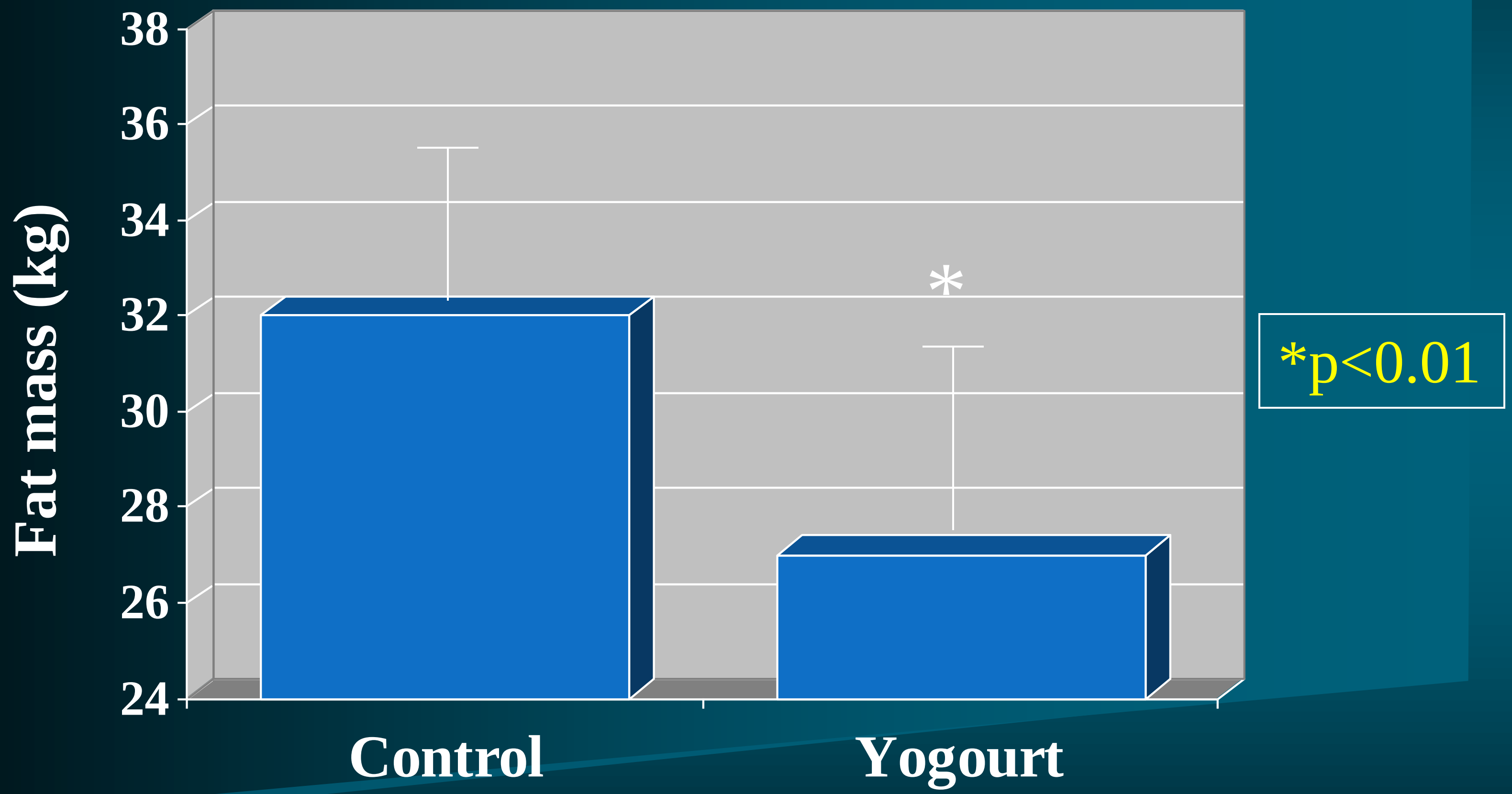
- Zemel documents the potential impact of calcium/dairy intake on body weight and fat

Effects of calcium or dairy intake on the risk of being in the highest quartile of body fat for women

Quartile of calcium and dairy intake	Calcium intake (mg/day; mean±SEM)	Dairy intake (serving/month; mean±SEM)	Odds ratio of being in the highest body fat quartile
1	255±20	14.4±1.9	1.00
2	484±13	38±1.3	0.75
3	773±28	57.2±1.0	0.40
4	1346±113	102.8±3.6	0.16

Adapted from Zemel *et al.* FASEB J 2000;14:1132-8.

Calcium and fat loss



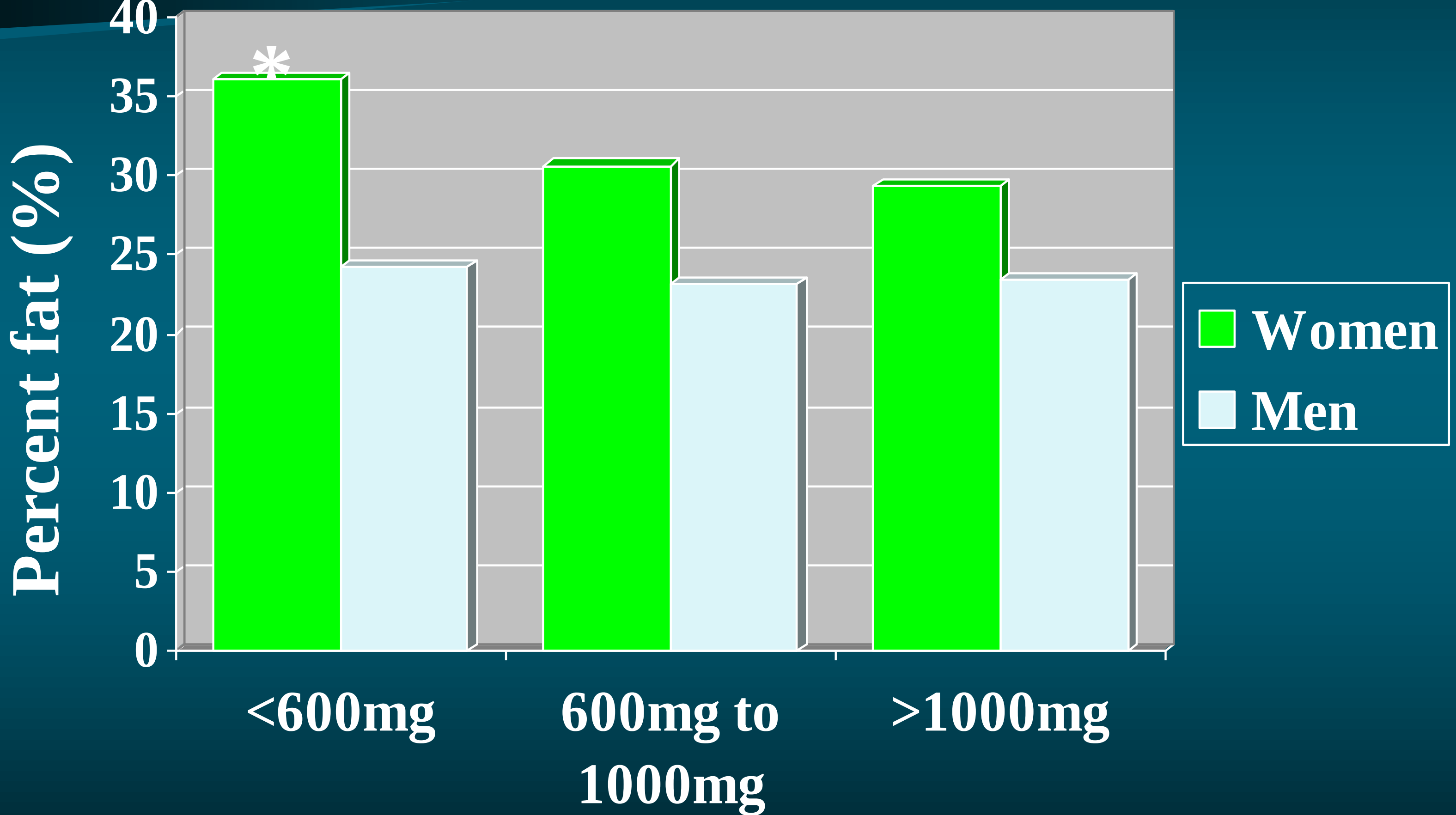
Adapted from Zemel *et al*. FASEB J 2000;14:1132-8.

Longitudinal calcium intake and body fat in children

- Dietary calcium intake was negatively related to percent body fat.
- Consumption of carbonated beverages and other sweetened beverages were negatively related to calcium intake.

Adapted from Skinner *et al*. J Am Diet Assoc 2003;103(12), 1626-31.

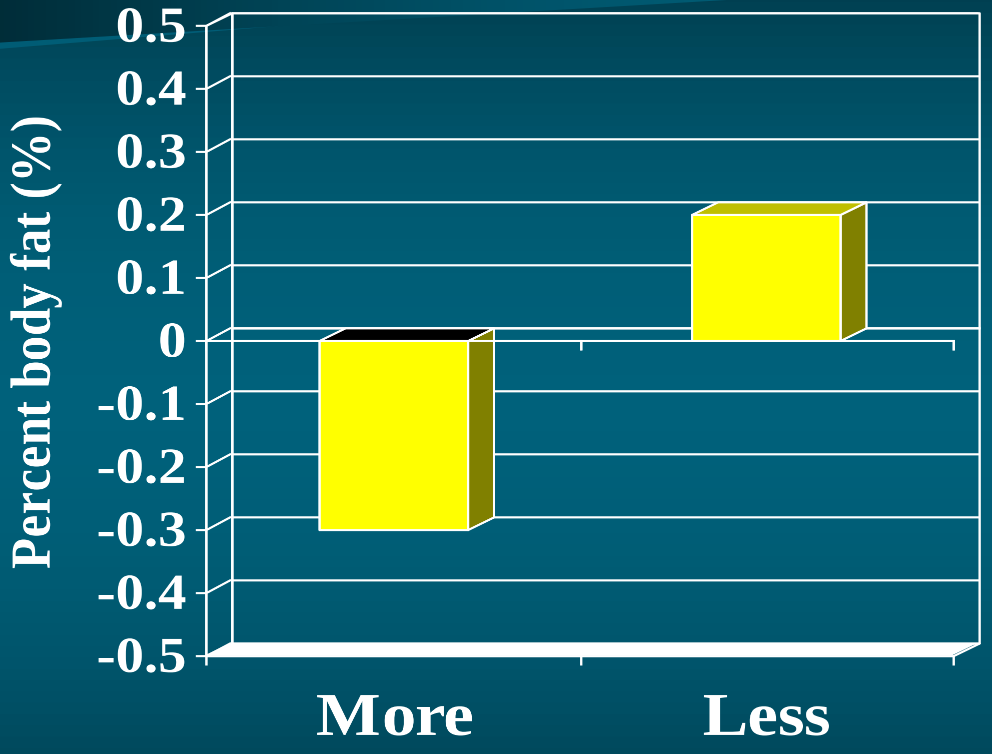
Percent body fat according to daily calcium intake in adults



* After adjustment, different from the other two groups in women, $p<0.05$

Adapted from Jacqmain *et al.* Am J Clin Nutr 2003;77:1448-52

Changes in percent body fat in relation to changes in milk/dairy intake



Ancova adjusting for age and percent body fat at Phase 2

Drapeau *et al*. Am J Clin Nutr. 2004; 80: 29-37

Calcium and dairy acceleration of weight and fat loss during energy restriction in obese adults

Zemel M, Thompson W. Milstead A, Morris K, and Campbell P.

Obes Res 12: 582-590, 2004

Objective

To determine the effects of increasing dietary calcium in the face of caloric restriction in humans

Key methodological points

- Recruitment of obese low calcium consumers (500-600mg/d)
- Testing under balanced deficit conditions (500 kcal/d deficit)
- Three testing conditions including a supplemented calcium diet and a high dairy diet containing the same amount of calcium (1200 to 1300 mg/day)
- Duration of the intervention: 24 weeks

Zemel M et al, Obes Res 12: 582-590, 2004.

Mean change in body weight and body fat

	Treatment		
	Low calcium	High calcium	High Dairy
Δ weight (kg)	6.60	8.58	11.07
Δ fat (kg)	4.81	5.61	7.16
Δ fat/ Δ weight	0.73	0.65	0.65

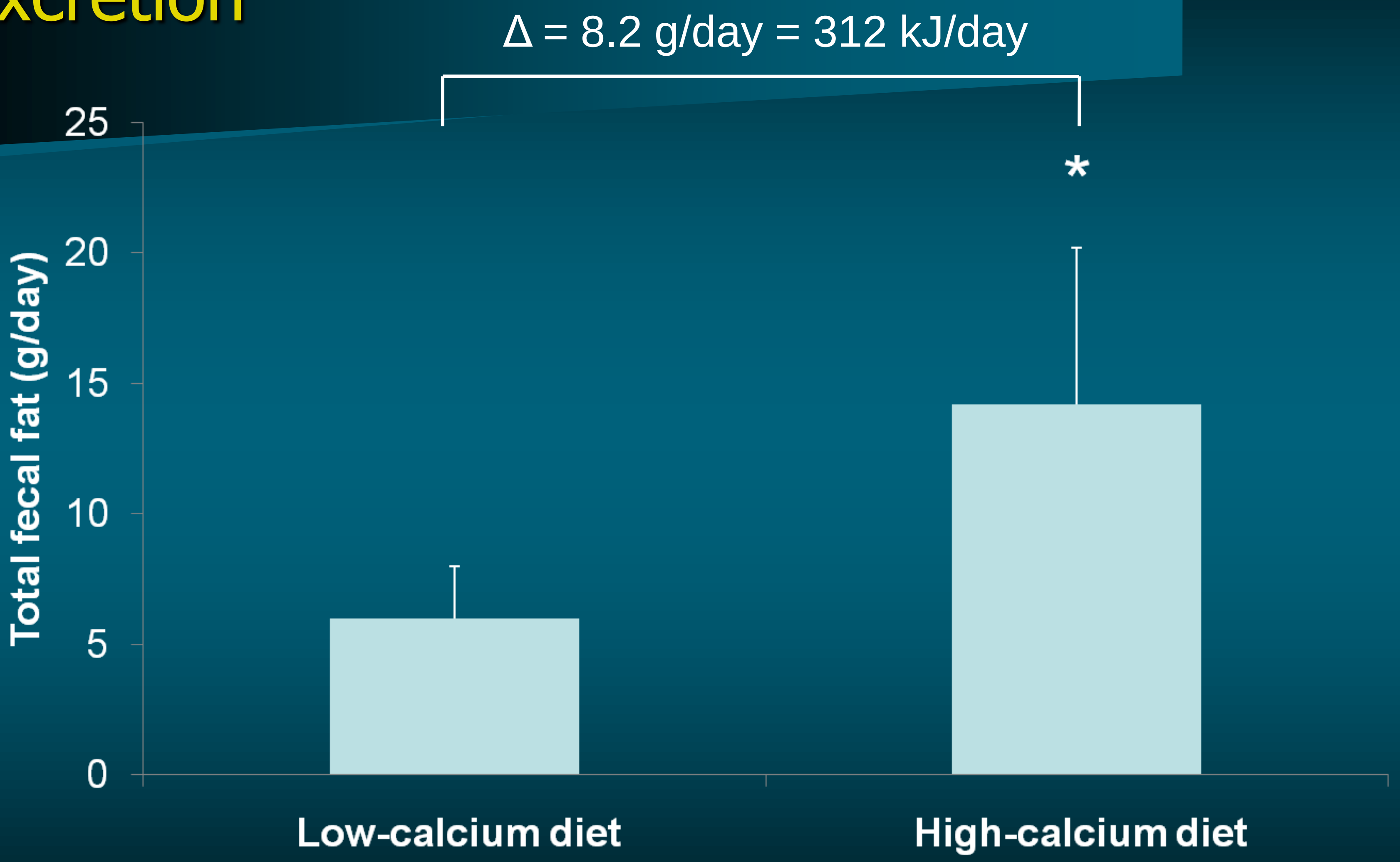
Adapted from Zemel M et al. Obes Res 12: 582-590, 2004.

An association between calcium or dairy intake and body composition:

WHY ?

Because of an effect on all components of fat balance

Calcium intake and fecal fat excretion



*p < 0.01.

Jacobsen R *et al.* Int J Obes 2005;29:292-301.

Effect of dairy calcium on fecal fat excretion: a randomized clinical trial

Diet	Mean total fecal fat excretion (g/day)
High Ca (2300 mg/day)	11.5*
Low Ca (700 mg/day)	5.4

* P < 0.001

From Bendsen NT et al, Int J Obes 32: 1816-24, 2008

Increased dairy calcium and postprandial lipidemia

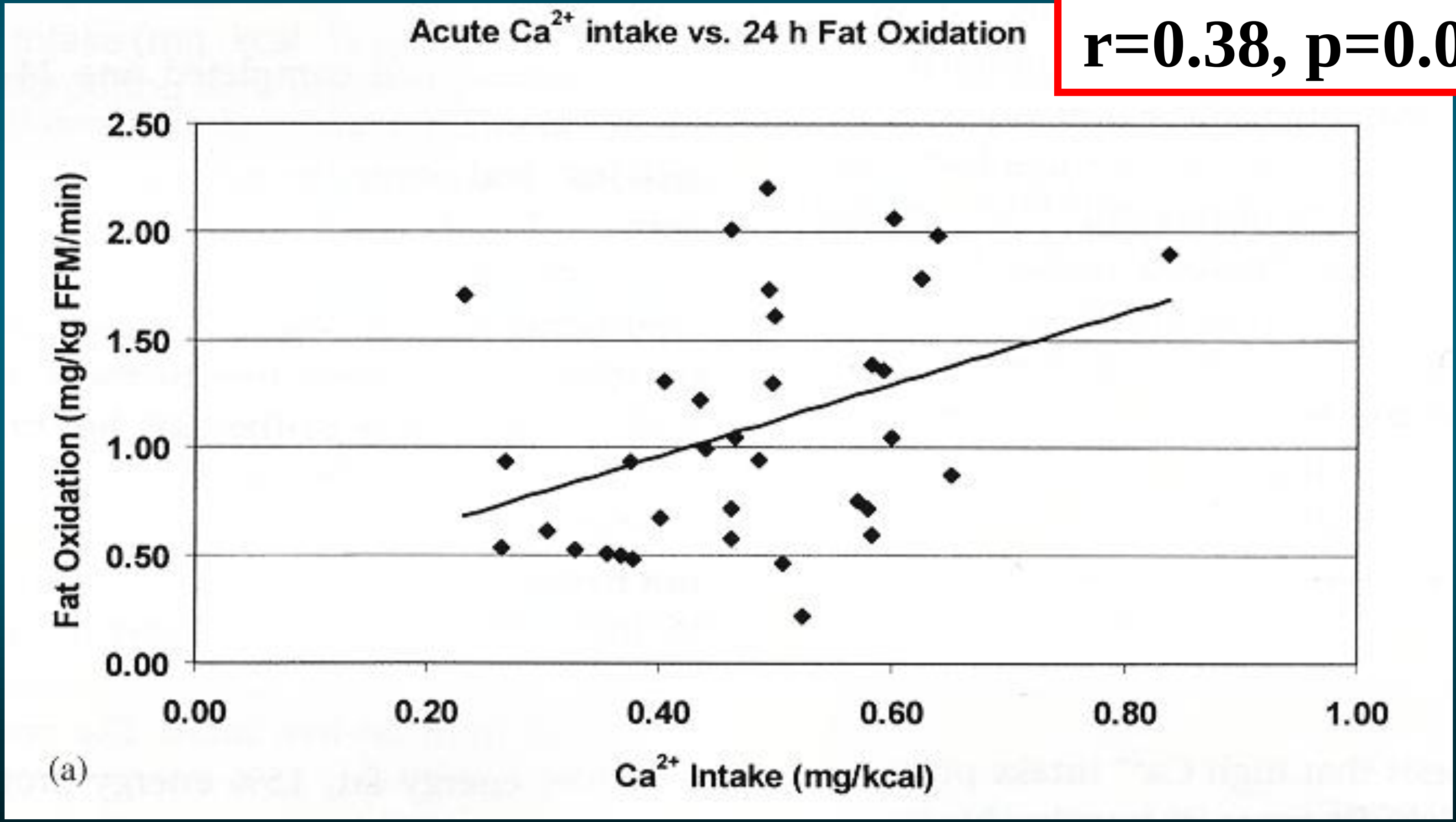
- 4 different isocaloric meals (randomized crossover design):

  HC (172 mg/MJ), MC (84 mg/MJ) or LC (15 mg/MJ) meals (calcium from dairy products) and Suppl (183 mg/MJ) (calcium carbonate supplement

- HC ⟹ ↓ 19% AUC chylomicron TG vs. LC meal
- MC ⟹ ↓ 17% AUC chylomicron TG vs. LC meal
- HC ⟹ ↓ 17% AUC chylomicron TG vs. Suppl meal
- MC ⟹ ↓ 15% AUC chylomicron TG vs. Suppl meal

Lorenzen JK *et al.* Am J Clin Nutr 2007;85:678-87.

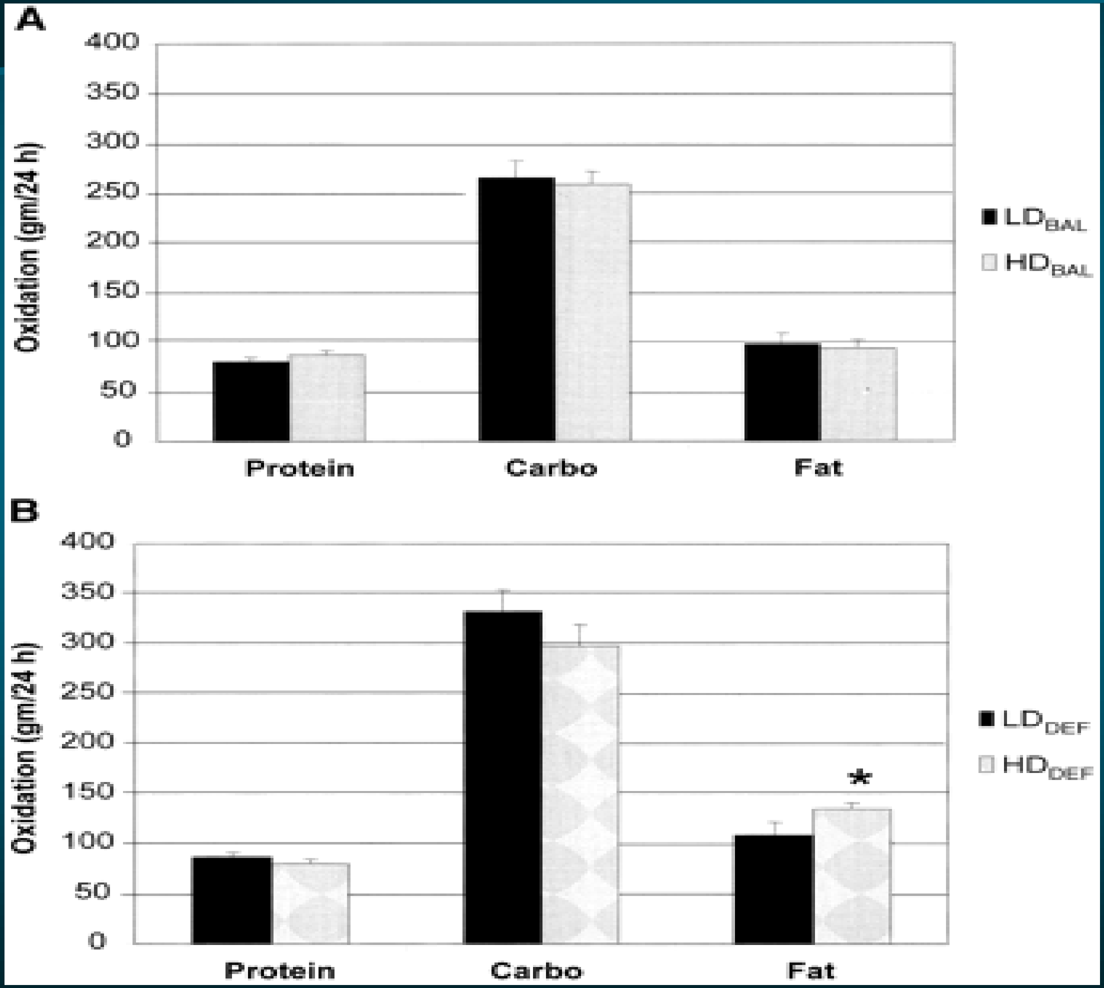
Relationship between 24-hour fat oxidation and acute calcium intake



r=0.38, p=0.03

Melanson EL *et al.* Int J Obes 2003;27:196-203.

Calcium intake and fat oxidation



Melanson EL *et al.* Obes Res 2005;13:2102-12.

« Rats fed with a low-calcium diet during 6 weeks developped a preference for $CaCl_2$ solution.
This indicates that rats deprived of an adequate source of calcium developped a calcium appetite ».

Paradis S and Cabanac M, *Physiology & Behavior,* 2005; 85: 259-64

« Calcium appetite is the motivation to seek out or choose calcium-containing items.
Calcium appetite might be compared with the appetite for glucose or energy, because unlike sodium homeostasis, these involve a reservoir (bone for calcium, glycogen and/or fat for glucose and energy)» .

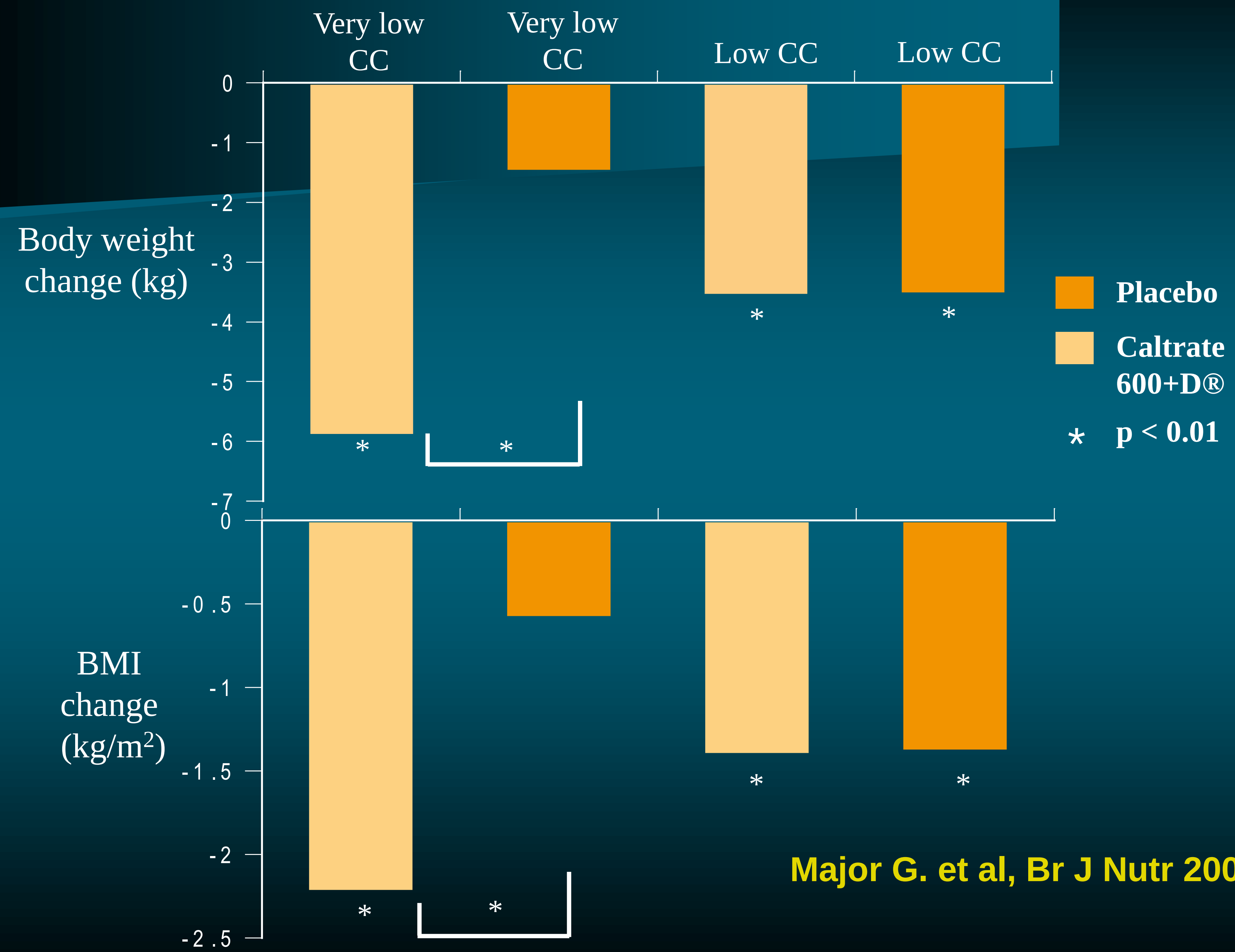
Tordoff MG, *Physiological Reviews*, 2001;81:1567-97.

Effect of calcium + vitamin D supplementation in obese women subjected to a weight-reducing program

Female obese very low-calcium consumers

- were unable to achieve a significant body weight loss despite careful dietary supervision when they received a placebo
- were the best responders in body weight loss when they received calcium + vitamin D supplementation (Caltrate)

Change in body weight and BMI between treatment groups



Major G. et al, Br J Nutr 2009

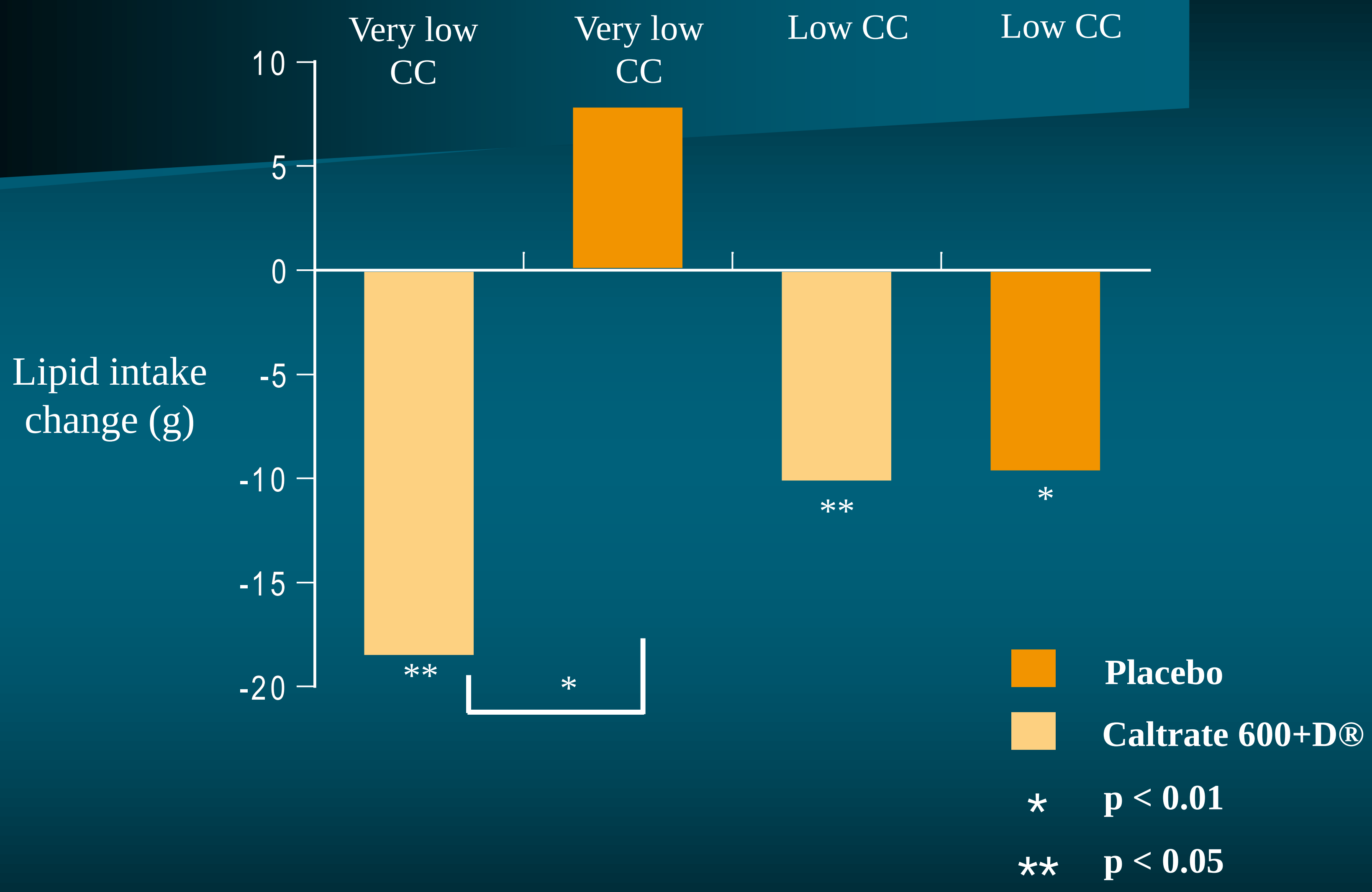
Partitioning of energy balance in very low calcium consumers subjected to calcium + vitamin D supplementation

Variable	Calcium + vitamin D	Placebo
Δ body weight (kg)	- 5.78	- 1.36
Δ fat mass (kg)	- 4.69	- 1.20
Δ fat-free mass (kg)	- 1.07	- 0.16
Energy equivalent of weight loss (kcal / 15 weeks)	44773	12821
Δ RMR (kcal / 15 weeks)[1]	4242	4043
Estimated excess fecal energy loss[2] (kcal / 15 weeks)	7350	_
Unexplained body energy Loss[3] (kcal / 15 weeks)	33181	8778

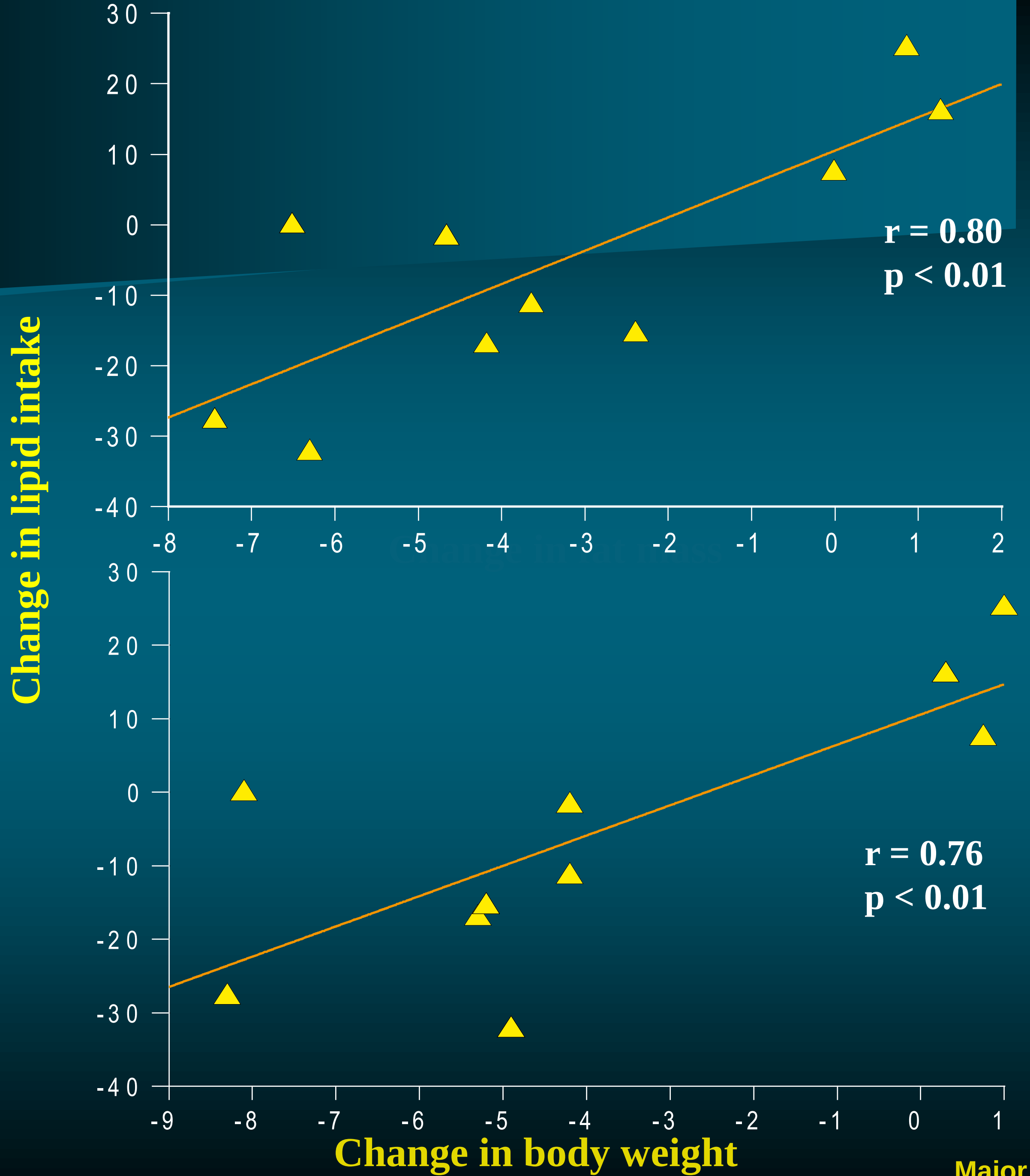
1) Measured change in daily RMR X 105 days; 2) Estimated excess fecal energy loss x 105 days;
3) Energy equivalent of weight loss minus (Δ RMR + estimated fecal energy loss)

Adapted from Major G. et al, Br J Nutr 2009

Change in lipid intake between treatment groups



Major G. et al, Br J Nutr 2009



Major G. et al, Br J Nutr 2009

Milk supplementation facilitates appetite control in obese women during weight loss: a randomised single blind-controlled trial

Jo-Anne Gilbert, Denis R. Joanisse, Jean-Philippe Chaput, Pierre Miegueu, Katherine Cianflone, Natalie Alméras and Angelo Tremblay

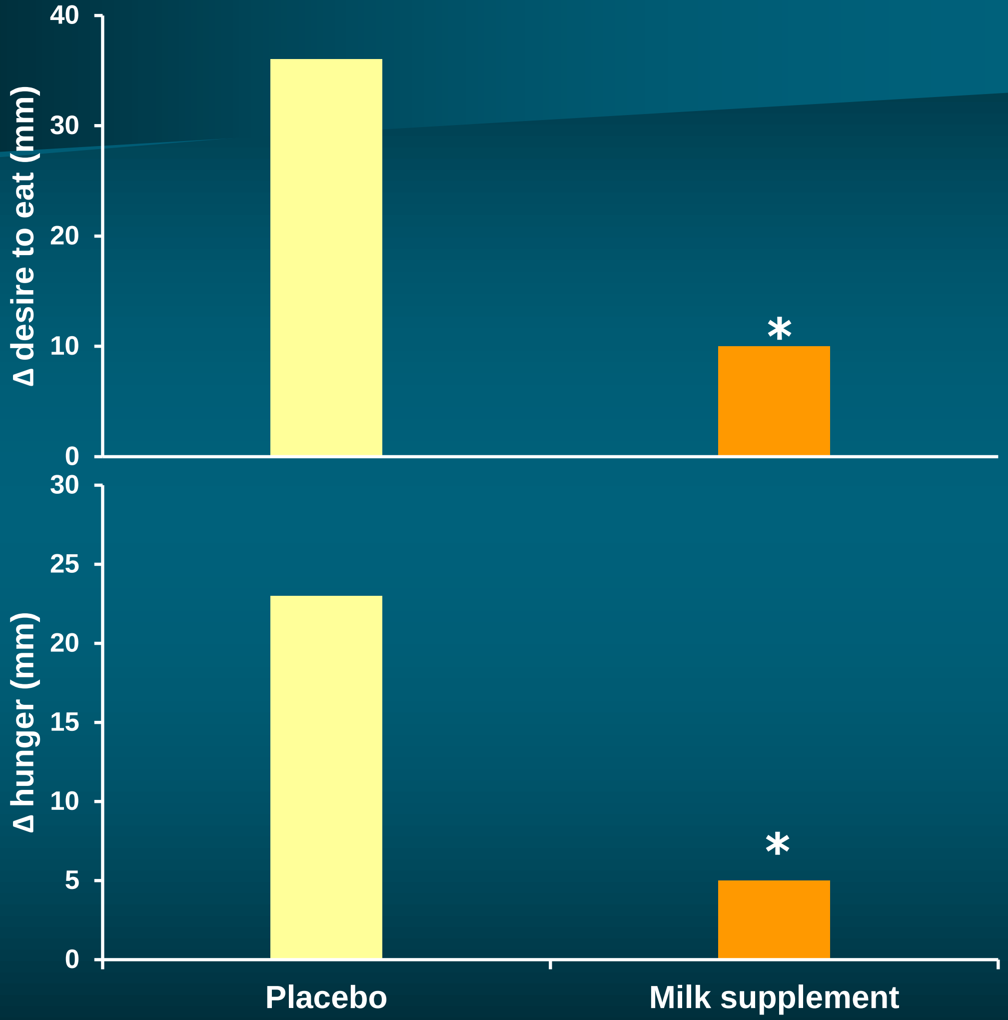
Br J Nutr 2010

Mean body weight and fat before and after the 6-month weight-reducing program

	Placebo		**Milk Supplement**	
	Before	After	Before	After
Body weight (kg)	86.2	80.4	87.9	79.9
Fat mass (kg)	41.6	36.6	39.5	33.5

Gilbert, J.-A. et al, Br J Nutr 2010

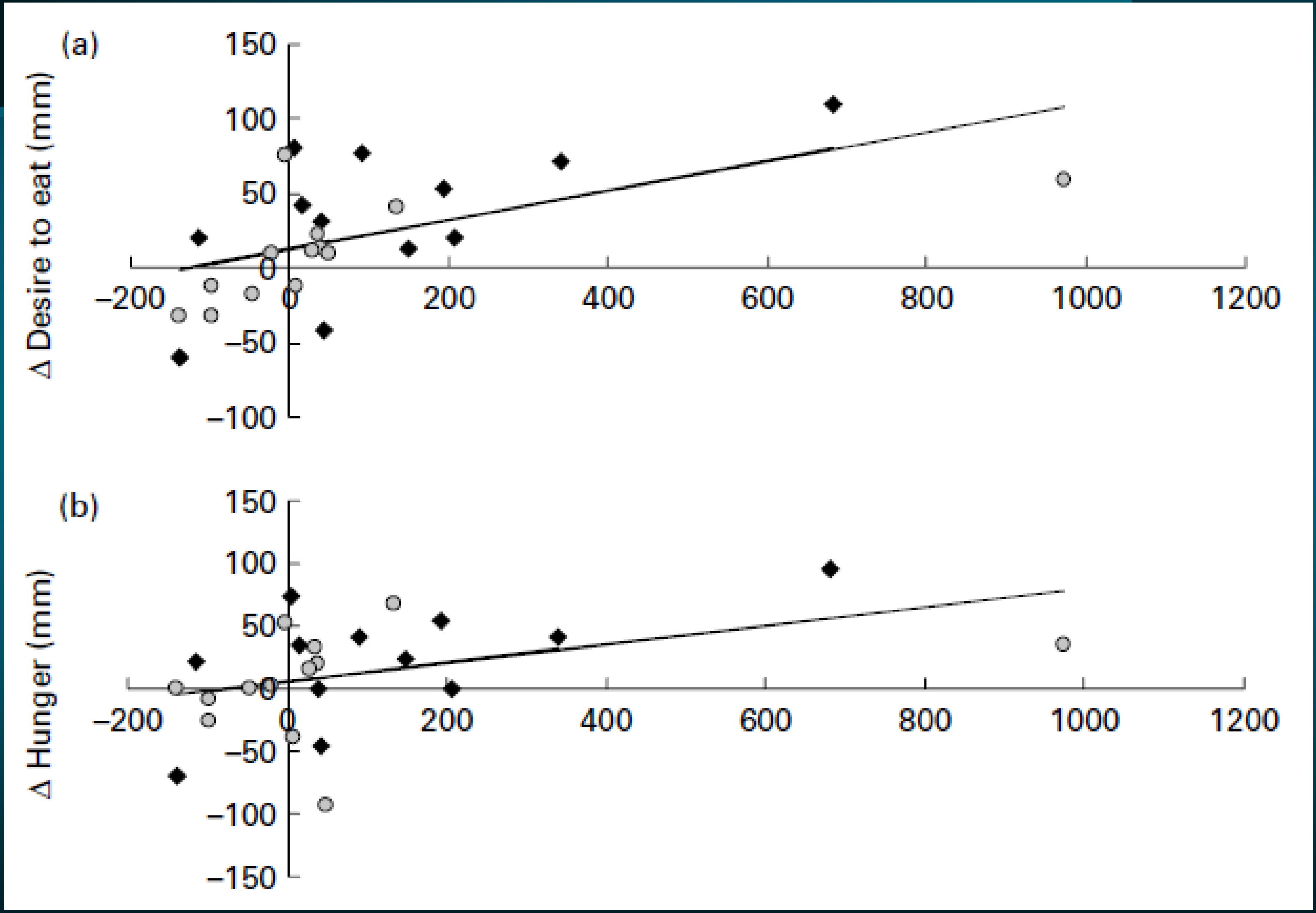
Mean change in desire to eat and hunger over the course of the 6-month weight-reducing program



* $p < 0.05$ after adjustment for weight loss

Adapted from Gilbert, J.-A. et al. Br J Nutr 2010

Changes in fasting appetite sensations in relation to changes in fasting ghrelin concentrations after 6 months of treatment in placebo and milk-supplemented groups



Gilbert, J.-A. et al, Br J Nutr 2010

Human obesity: is insufficient calcium/dairy intake part of the problem? YES

- Low calcium/dairy intake increases the risk to gain body fat
- Calcium/dairy supplementation reverses these effects, particularly in low dairy consumers

How can we explain that low dietary calcium intake has a better predictability of overweight than high dietary lipid intake and non-participation in high-intensity physical exercise?

A potential increase in:

- fat oxidation
- intestinal fat loss
- satiety