

# Dietary Saturated Fats in a Healthy Lifestyle

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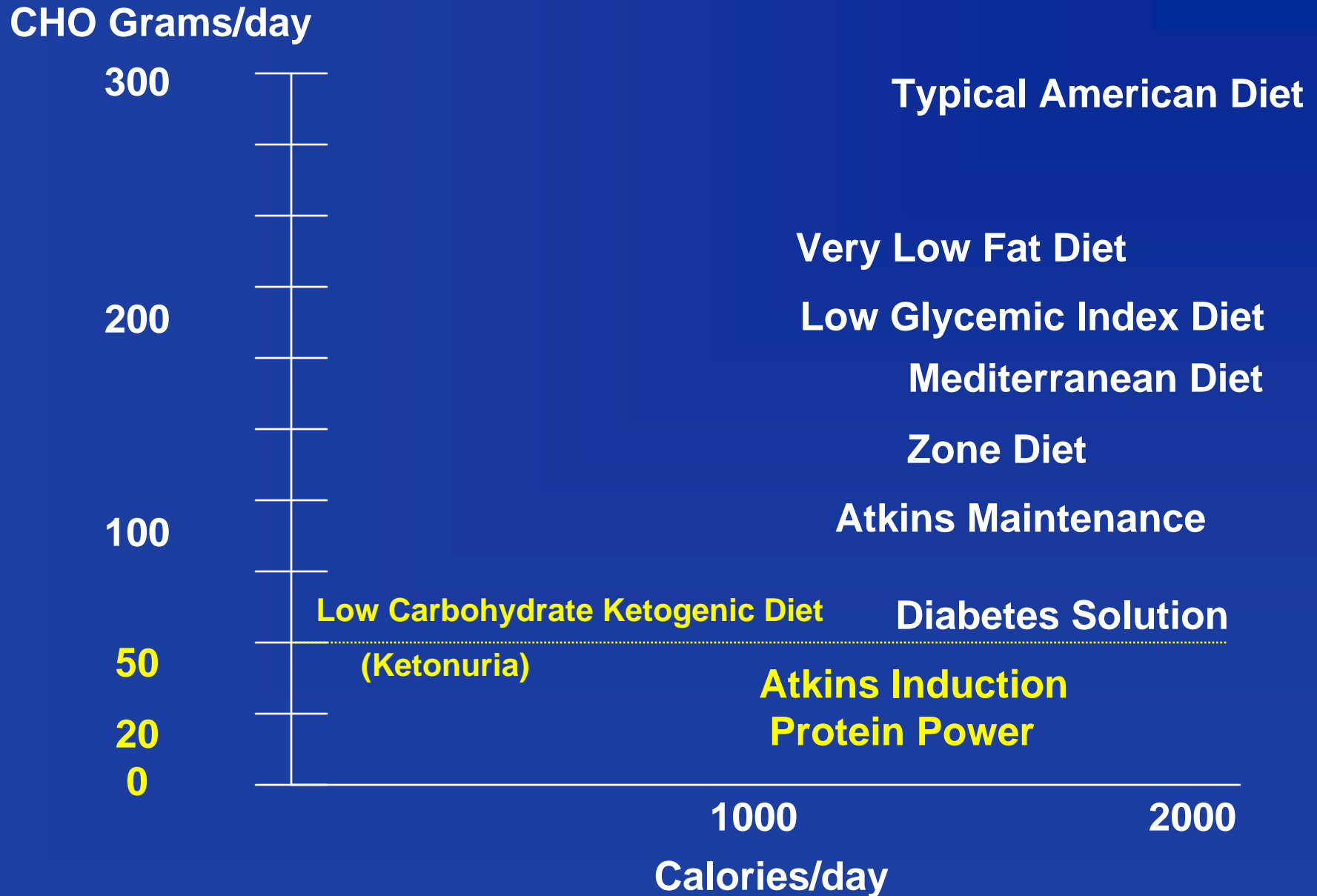
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Research Funding: The Robert C. Atkins Foundation

# Diets, Carbohydrates and Calories



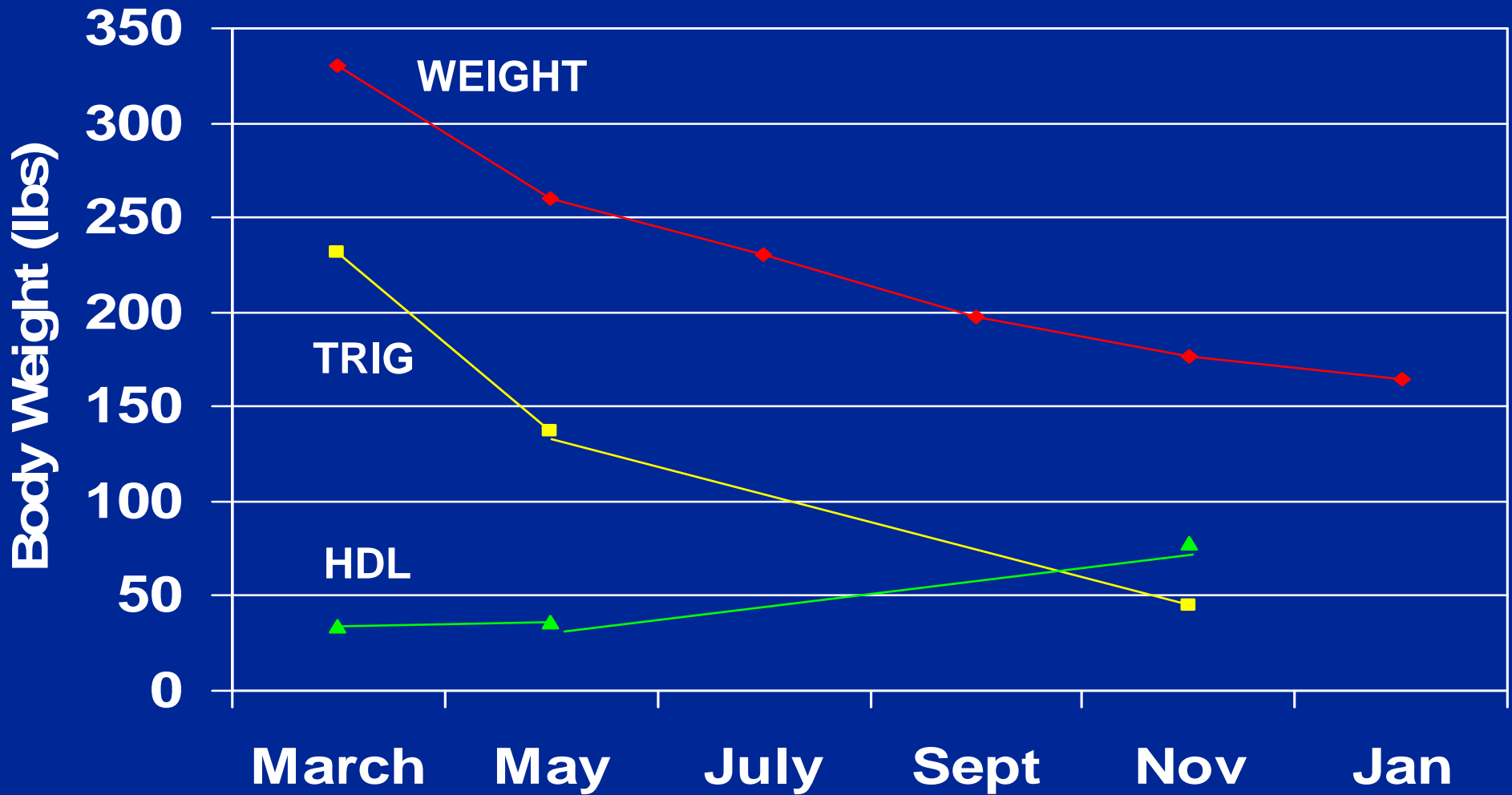






**Spironolactone, coumadin d/c'd**

**CPAP d/c'd**



# Typical Daily Food Intake

## Low Carbohydrate Ketogenic Diet ( $< 20$ grams carbohydrate per day)

- Eggs, bacon, coffee w/ cream
- Chicken Caesar salad, diet soda
- Snack: olives, cheese stick
- Steak with bleu cheese, broccoli, water

# Outpatient LCKD Randomized Controlled Trials: Design

Reference	Design	Setting	Patients	Duration	Visits
Sondike 2003	RCT	Clinic	Healthy teens	3m	q2Wk
Brehm 2003	RCT	Clinic	Healthy adults	6m	q2Wk x 6, then @ 6mo
Samaha 2003 Stern 2004	RCT	Clinic	Outpt adults	6m 12m	qWk x 4, then monthly
Foster 2003	RCT	Clinic	Healthy adults	12m	q2Wk x 2, q4Wk x 4, then Wk 26, 34, 42, 52
Yancy 2004	RCT	Clinic	Healthy adults	6m	q2Wks x 6, then monthly
Meckling 2004	RCT	Clinic	Healthy adults	2.5m	weekly

Nordmann et al. Arch Intern Med 2006;166:285-293.

# Outpatient LCKD RCTs: Weight Loss and Serum Lipids

## Low Fat

## Low Carbohydrate

Ref	Duration	Weight	LDL	Trig	HDL	Weight	LDL	Trig	HDL
Sondike n=30	3 mo	-4.1kg	<b>-17%*</b>	-6%	+2%	<b>-9.9kg*</b>	+4%	<b>-48%*</b>	+4%
Brehm n=42	6 mo	-3.9kg <sup>†</sup>	-5%	+2%	+8%	<b>-8.5kg*<sup>†</sup></b>	0%	<b>-23%*</b>	+13%
Samaha/ Stern n=132	6 mo 12 mo	-1.9kg <sup>†</sup> -3.1kg	+3% -3%	-4% +2%	-2% -12%	<b>-5.8kg*<sup>†</sup></b> -5.1kg	+4% +6%	<b>-20%*</b> <b>-29%</b>	0% <b>-2%</b>
Foster n=63	6 mo 12 mo	-5.3kg <sup>†</sup> -4.5kg <sup>†</sup>	-3% -6%	-13% +1%	+4% +3%	<b>-9.7kg*<sup>†</sup></b> -7.3kg <sup>†</sup>	+4% +1%	-21% <b>-28%*</b>	<b>+20%*</b> <b>+18%*</b>
Yancy n=119	6 mo	-6.5kg	-3%	-15%	-1%	<b>-12.0kg*</b>	+2%	<b>-42%*</b>	<b>+13%*</b>
Meckling N=40	10 wks	-6.8kg	<b>-32%</b>	-25%	-15%	-7.0kg	0%	-29%	<b>+12%</b>

\* p<0.05 for between-groups comparison

# Workplace Diet Trial

322 workers at Israeli research center, BMI >27 kg/m<sup>2</sup>

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## Low Fat Diet

- <30% fat
- Calorie-restricted
- Grains, vegies, fruits, legumes

## Mediterranean Diet

- <35% fat
- Calorie-restricted
- Add fish, nuts, olive oil

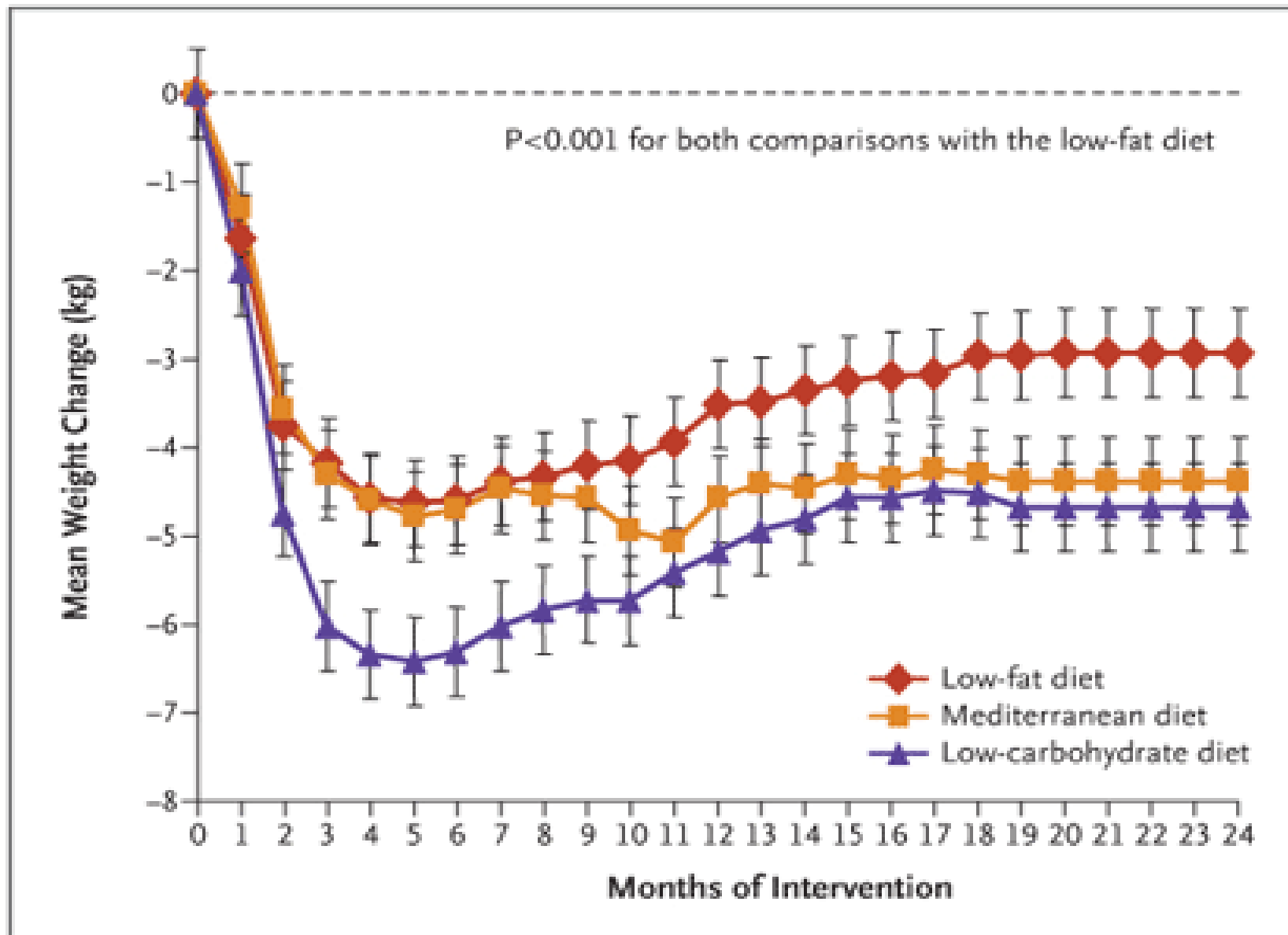
## Low Carb Diet

- <20 g/day carbs initially
- Increase to max of 120 g/day
- No calorie restriction

# Workplace Diet Trial

- Treatment Program
  - Group counseling (17-19 per group) by dietitian
  - 18 sessions (90 minutes each) over 2 years
  - Up to 6 phone calls by dietitian to increase motivation
  - No financial incentives or gifts
- Cafeteria food-labeling
  - Lunch is main meal in Israel
  - All foods color-coded by diet

# Weight Changes over 2 Years by Diet Group



# Workplace Diet Trial: Serum Tests

Test	Low Fat	Mediterranean	Low Carb.
Systolic BP, mm Hg	-4.3	-5.5	-3.9
Diastolic BP, mm Hg	-0.9	-2.2	-0.8
LDL-C, mg/dl	-0.05	-5.6	-3.0
HDL-C, mg/dl	6.3	6.4	8.4
Triglyceride, mg/dl	-2.8	-21.8	-23.7
T Chol : HDL ratio	-0.6	-0.9	-1.1
Hemoglobin A1c, %	-0.4	-0.5	-0.9
C-reactive protein, mg/l	-0.6	-0.9	-1.3

**Yellow denotes p<0.05 for within-group change from baseline.**

**Blue denotes p<0.05 for comparison of Low Carb vs Low Fat.**

# Popular Diet Effects on Weight Cardiac Risk Among Women

“Each diet group attended 1-hour classes led by a registered dietician once per week for 8 weeks and covered approximately one eighth of their respective books per class...Efforts to maximize retention included email and telephone reminders...and incentive payments.”

## 2 months (“efficacy”)

Group	n	kcal/d	CHO	PRO	FAT	Weight	LDL	Trig	HDL	DBP
Atkins	77	1381	~62g	97	84	-4.3 kg	+2.3	-52.3	-0.4	-2.9
Zone	79	1455	152	87	57	-2.0 kg	-5.3	-24.8	-0.5	-2.1
LEARN	79	1476	180	73	49	-2.8 kg	-7.3	-17.2	-3.8	-1.4
Ornish	76	1408	220	60	33	-2.8 kg	-10.1	-10.9	-5.3	-0.4

## 12 months (“effectiveness”)

Group	n	kcal/d	CHO	PRO	FAT	Weight	LDL	Trig	HDL	DBP
Atkins	77	1599	~140g	84	78	-4.5 kg	+0.8	-29.3	+4.9	-4.4
Zone	79	1594	179	80	62	-1.5 kg	0	-4.2	+2.2	-2.1
LEARN	79	1654	194	79	61	-2.5 kg	+0.6	-14.6	-2.8	-2.2
Ornish	76	1505	195	68	50	-2.4 kg	-3.8	-14.9	0	-0.7

# Popular Diet Effects on Weight Loss and Cardiac Risk Factors

“To approximate the realistic long-term sustainability of each diet, we asked participants to follow their dietary assignment to the best of their ability to their 2 month assessment, after which time we encouraged them to follow their assigned diet according to their own self-determined interest level.”

## 2 months (“efficacy”)

<u>Group</u>	<u>n</u>	<u>kcal/d</u>	<u>CHO</u>	<u>PRO</u>	<u>FAT</u>	<u>Weight</u>	<u>LDL</u>	<u>Trig</u>	<u>HDL</u>	<u>L/H</u>
Atkins	40	1736	137g	93.5	89.5	-3.6 kg	+1.3	-32.3	+3.2	-0.18
Zone	40	1434	157	90.4	54.5	-3.8 kg	-9.7	-54.1	+1.8	-0.33
WWatchers	40	1615	191	80.5	54.5	-3.5 kg	-12.1	-9.2	-0.2	-0.42
Ornish	40	1393	230	70.0	27.5	-3.6 kg	-16.5	-0.4	-3.6	-0.21

## 12 months (“effectiveness”)

<u>Group</u>	<u>n</u>	<u>kcal/d</u>	<u>CHO</u>	<u>PRO</u>	<u>FAT</u>	<u>Weight</u>	<u>LDL</u>	<u>Trig</u>	<u>HDL</u>	<u>L/H</u>
Atkins	40	1886	190g	86.0	80.5	-2.1 kg	-7.1	-1.2	+3.4	-0.39
Zone	40	1757	173	90.4	71.5	-3.2 kg	-11.8	-2.5	+3.3	-0.52
WWatchers	40	1832	208	82.5	64.0	-3.0 kg	-9.3	-12.7	-3.4	-0.55
Ornish	40	1819	218	76.5	64.0	-3.3 kg	-12.6	+5.6	-0.5	-0.31

# Effect of Diet Programs on Metabolic Syndrome Parameters From Baseline to 12 Months

	Atkins (n=77)	Zone (n=79)	LEARN (n=79)	Ornish (n=76)	P value
BMI, kg/m <sup>2</sup>	-1.65	-0.53	-0.92	-0.77	.01
Waist-hip ratio	-0.019	-0.013	-0.009	-0.012	.10
HDL-C, mg/dL	+4.9	+2.2	+2.8	0.0	0.002
Triglycerides, mg/dL	-29.3	-4.2	-14.6	-14.9	0.01
Non-HDL-C, mg/dL	-5.1	-0.5	-4.0	-6.8	0.36
Insulin, $\mu$ U/mL	-1.8	-1.5	-1.8	-0.2	0.17
Glucose, mg/dL	-1.8	-1.6	+0.5	-0.8	0.54
Diastolic b.p., mmHg	-4.4	-2.1	-2.2	-0.7	0.009
Systolic b.p., mmHg	-7.6	-3.3	-3.1	-1.9	<0.001

# Low Carbohydrate Ketogenic Diet Mechanism

- When dietary carbohydrate is restricted, appetite is suppressed <sup>1</sup>
- Appetite suppression leads to a Calorie deficit state <sup>1</sup>
- In a Calorie deficit state, the body draws on stored fat for fuel (lipolysis) <sup>1</sup>

## Possible but as yet unproven mechanisms

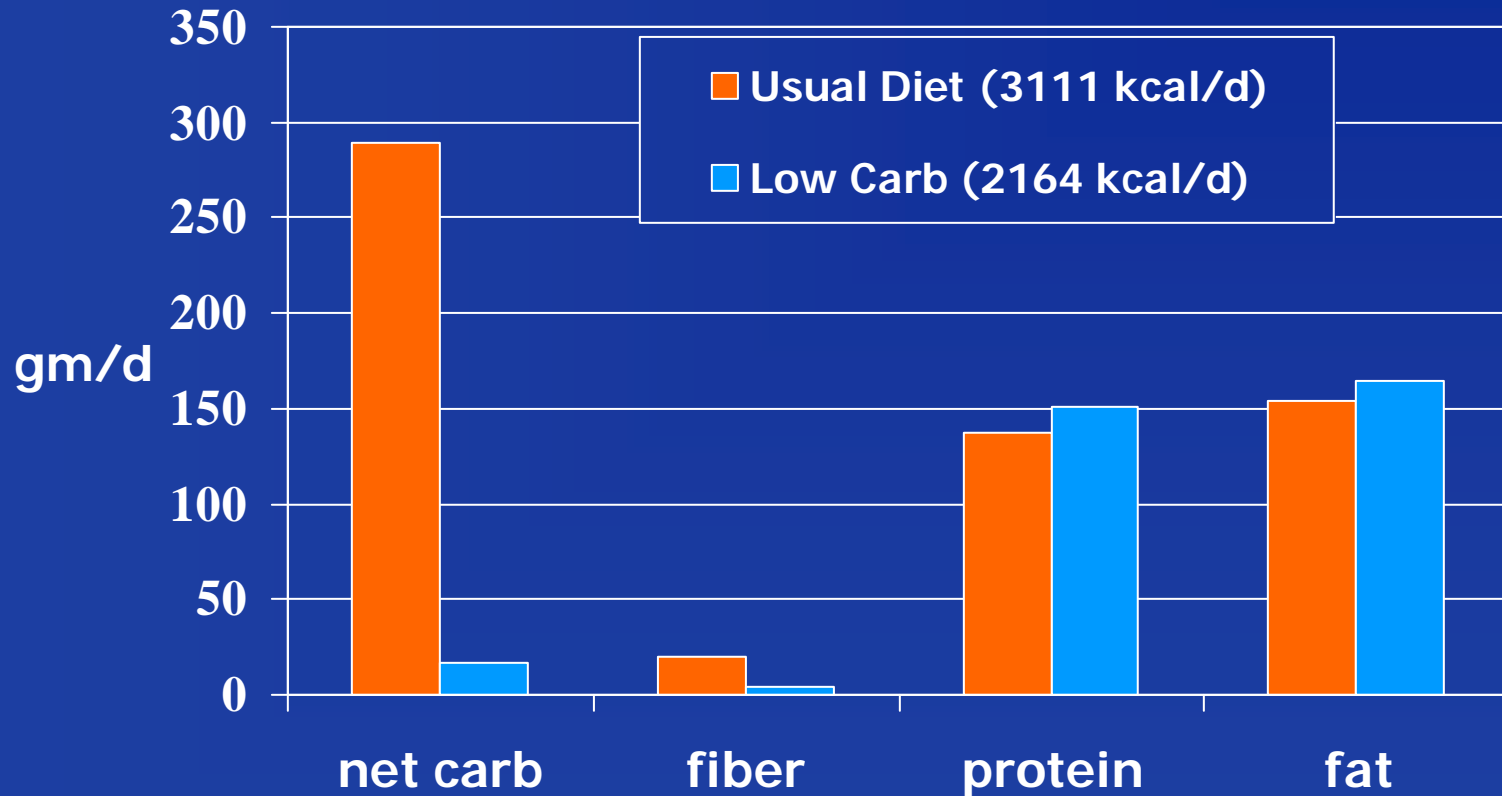
- Inefficiency of protein and fat processing leads to extra energy loss <sup>2</sup>
- Lipolysis is maintained despite calorie excess state because glycerol from fat is needed as a gluconeogenic precursor <sup>3</sup>

1. Boden G et al. Effect of a low-carbohydrate diet on appetite, blood glucose levels, and insulin resistance in obese patients with type 2 diabetes. *Ann Intern Med* 2005;142:403-411.

2. Feinman RD, Fine EJ. Thermodynamics and metabolic advantage of weight loss diets. *Metabolic Syndrome and Related Disorders* 2003;1:209-219.

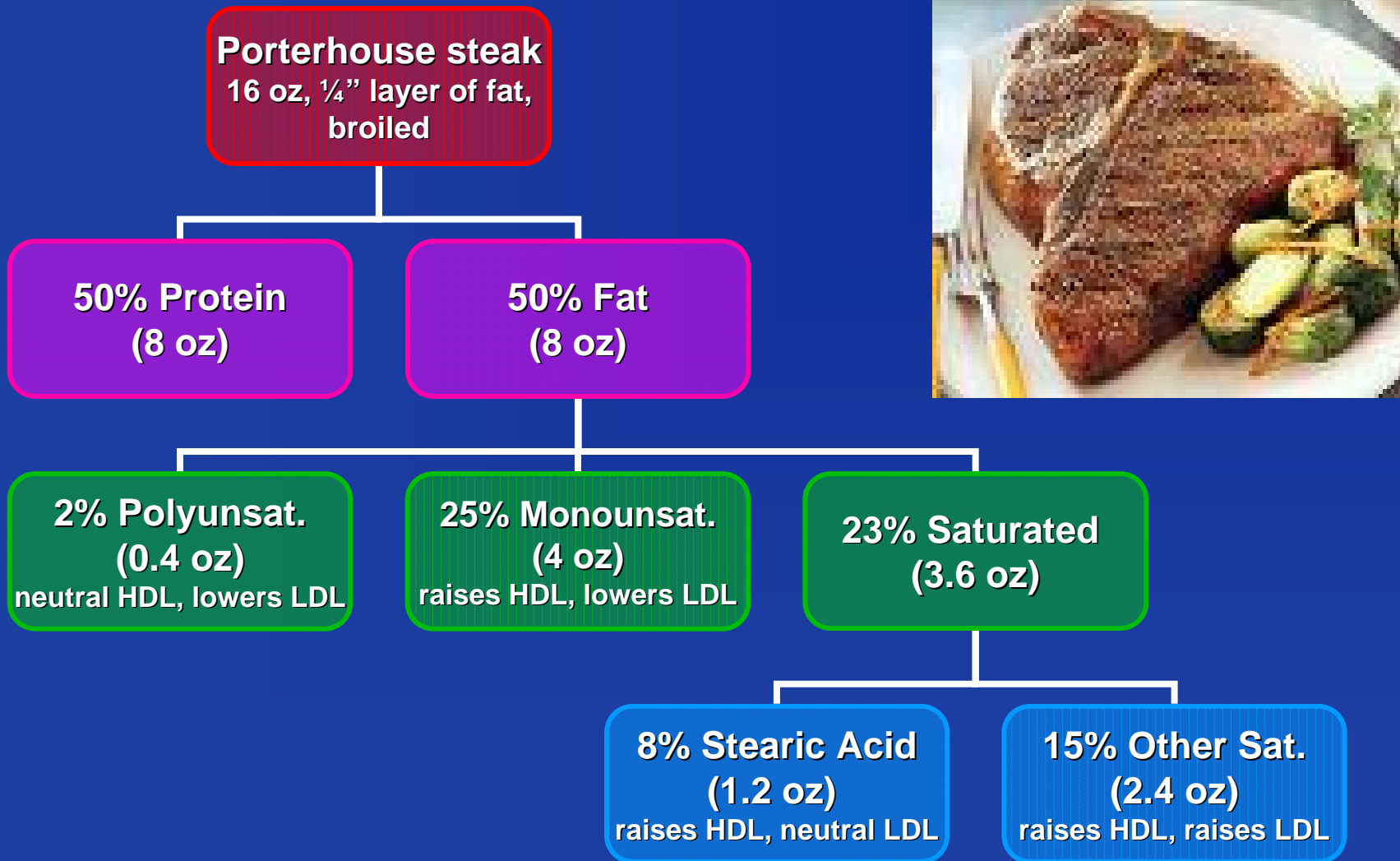
3. Klein S, Wolfe RR. Carbohydrate restriction regulates the adaptive response to fasting. *Am J Physiol* 1992;262:E631-E636.

# Low Carbohydrate Diet Composition



Boden G et al. Effect of a low-carbohydrate diet on appetite, blood glucose levels, and insulin resistance in obese patients with type 2 diabetes. *Ann Intern Med* 2005;142:403-411.

# Composition of a Porterhouse Steak



**Table 3: Nutrient intake by dietary treatment during weight loss and weight maintenance assessed using weighed food records<sup>12</sup>**

Nutrient	VLCARB		VLF		HUF	
	Weight loss	Maintenance	Weight loss	Maintenance	Weight loss	Maintenance
Energy (kJ)	6193 (± 82)	7706 (± 167)	6061 (± 168)	7000 (± 333)	5996 (± 88)	7659 (± 201)
% energy protein <sup>3</sup>	33.1 (± 0.85)	30.5 (± 0.91)	19.9 (± 0.33)	20.3 (± 0.55)	22.6 (± 0.46)	21.4 (± 0.51)
% energy fat <sup>3</sup>	55.1 (± 1.96)	54.3 (± 2.53)	11.7 (± 0.32)	12.5 (± 0.59)	27.4 (± 0.84)	28.0 (± 0.88)
% energy carbohydrate <sup>3</sup>	8.8 (± 2.71)	12.4 (± 3.38)	67.7 (± 0.60)	66.0 (± 0.92)	47.9 (± 0.83)	48.7 (± 1.07)
% energy saturated fat <sup>4</sup>	17.6 (± 0.77)	17.7 (± 1.01)	4.5 (± 0.16)	5.1 (± 0.30)	5.4 (± 0.18)	6.0 (± 0.32)
% energy MUFA <sup>3</sup>	27.0 (± 1.16)	26.2 (± 1.41)	3.3 (± 0.11)	3.6 (± 0.21)	12.0 (± 0.48)	12.3 (± 0.51)
% energy PUFA <sup>3</sup>	6.3 (± 0.13)	6.5 (± 0.28)	1.7 (± 0.03)	1.8 (± 0.16)	7.6 (± 0.29)	7.2 (± 0.30)
Calcium (mg) <sup>5</sup>	959 ± 14	1297 ± 58	867 ± 32	1079 ± 55	969 ± 19	1169 ± 43

<sup>1</sup> mean ± SEM, VLCARB = very low carbohydrate (n = 24) VLF= very low fat (n = 22) HUF = high unsaturated fat (n = 21)

**MUFA** = monounsaturated fat, **PUFA** = polyunsaturated fat

**Table 2A: Food profile of treatment diets**

VLCARB	VLF	HUF
Cheese, full fat	70 g	High fibre cereal
Milk, full fat	125 g	Bread, wholegrain
Lean meat, chicken	350 g	Low fat biscuits
Eggs	2	Milk, skim
Very low carbohydrate vegetables	2 cups	Cheese full fat
Almonds	50 g	Yoghurt, skim
Butter	20 g	Pasta or rice, dry
		Nuts, mixed
		Salad vegetables
		Fresh fruit
		Pulses, cooked
		Lean meat, chicken,
		Fish
		Sardines
		Tuna
		Low carbohydrate vegetables
		Potato
		Unsaturated oil or margarine
		32 g
		70 g
		300 g
		20 g 2/week
		200 g × 3/week
		100 g × 4/week
		20 g
		100 g
		300 g
		100 g × 2/week
		150 g 5/week
		150 g/week
		3 whole/week
		50 g × 2/week
		1.5 cups
		1 × 3/week
		25 g

Noakes M, Foster PR, Keogh JB, James AP, Mamo JC, Clifton PM. Comparison of isocaloric very low carbohydrate/high saturated fat and high carbohydrate/low saturated fat diets on body composition and cardiovascular risk. *Nutrition & Metabolism* 2006;3:7.

# Low Carb Diets: Fatty Acid Intake

**TABLE 2.** Mean nutrient intake of women before and after 3 and 6 months of dieting

	Baseline	3 months	6 months
Very low carbohydrate diet group (n = 22)			
Carbohydrate (g)	188.92	41.13 <sup>c</sup>	96.98 <sup>c</sup>
Protein (g)	63.32	78.15 <sup>c</sup>	74.13 <sup>c</sup>
Total fat (g)	65.79	71.32 <sup>c</sup>	65.45 <sup>c</sup>
→ Saturated fat (%)	12.4	20.7 <sup>c</sup>	17.4 <sup>b</sup>
Monounsaturated fat (%)	10.1	20.6 <sup>c</sup>	15.8 <sup>c</sup>
Polyunsaturated fat (%)	6.2	9.0 <sup>c</sup>	8.2 <sup>c</sup>
Cholesterol (mg)	215.25	460.87 <sup>c</sup>	285.44 <sup>b</sup>
Vitamin C (mg)	70.28	35.65 <sup>c</sup>	58.46
Folate (μg)	155.14	139.65	195.89
Calcium (mg)	590.81	444.20	739.01
Fiber (g)	12.03	5.27 <sup>c</sup>	8.40 <sup>c</sup>

# Summary

- Instructing people to limit carbohydrate grams leads to a spontaneous reduction in caloric intake (without explicitly limiting calories) and:
  - Loss of body weight
  - Improvements in fasting serum lipid profiles (triglyceride, HDL, chol/HDL ratio)
  - Improvement in systolic blood pressure
  - Reduction in waist circumference
- Low carbohydrate diets are effective in the context of high fat and high saturated fat intake
- Dietary saturated fat can play a role in a healthy dietary pattern