

# A New Paradigm for Saturated Fats

Eric C. Westman, M.D. M.H.S.

Duke University Medical Center, Durham NC

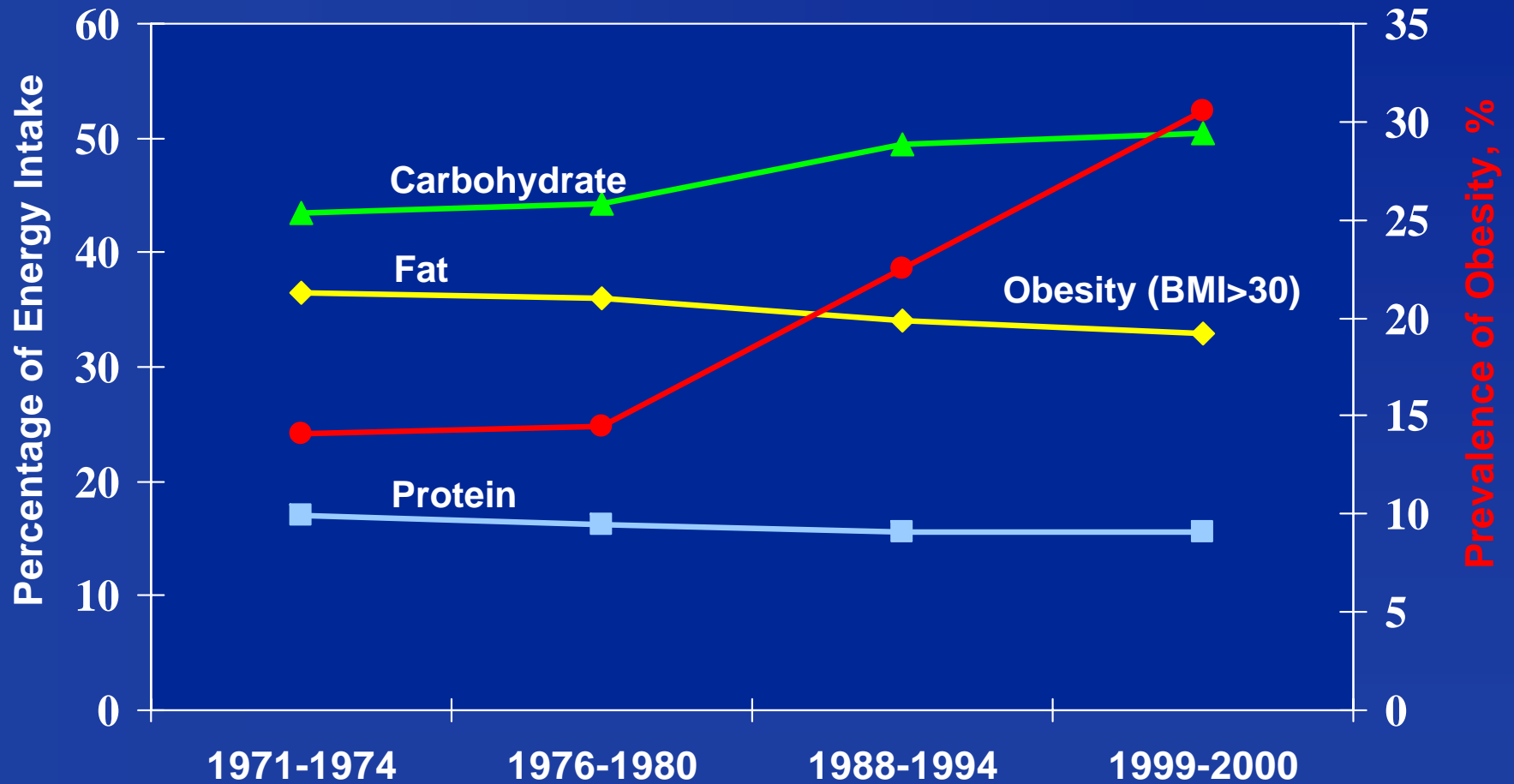
[ewestman@duke.edu](mailto:ewestman@duke.edu)

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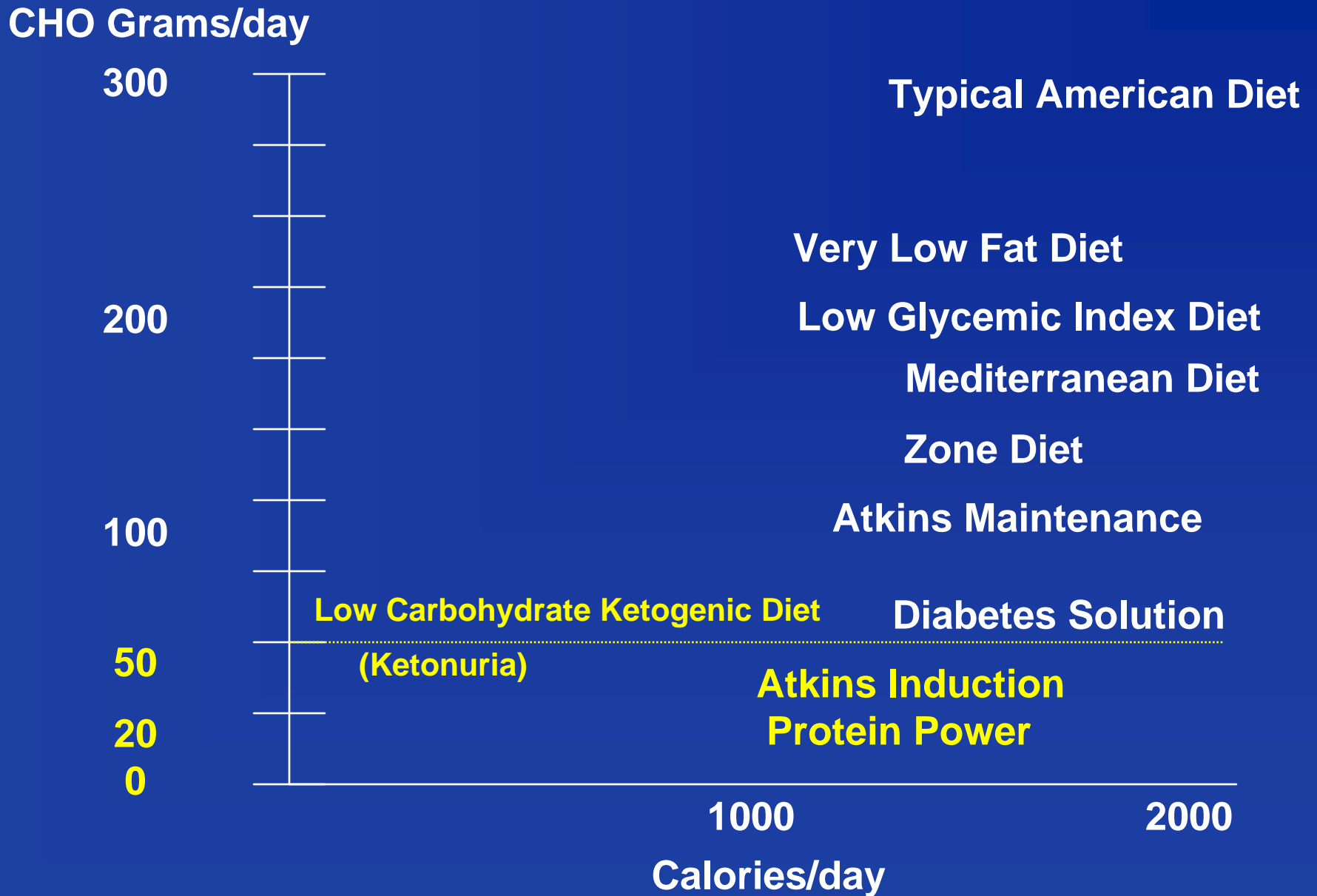
# Trends in Macronutrient Intake and Obesity



Based on NHANES data.

Int J Obes 1998;22:39-47. JAMA 2002;288:1723. MMWR 2004;53:80-82.

# Diets, Carbohydrates and Calories



## 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

Ref	Duration	Low Fat				Low Carbohydrate			
		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

# 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

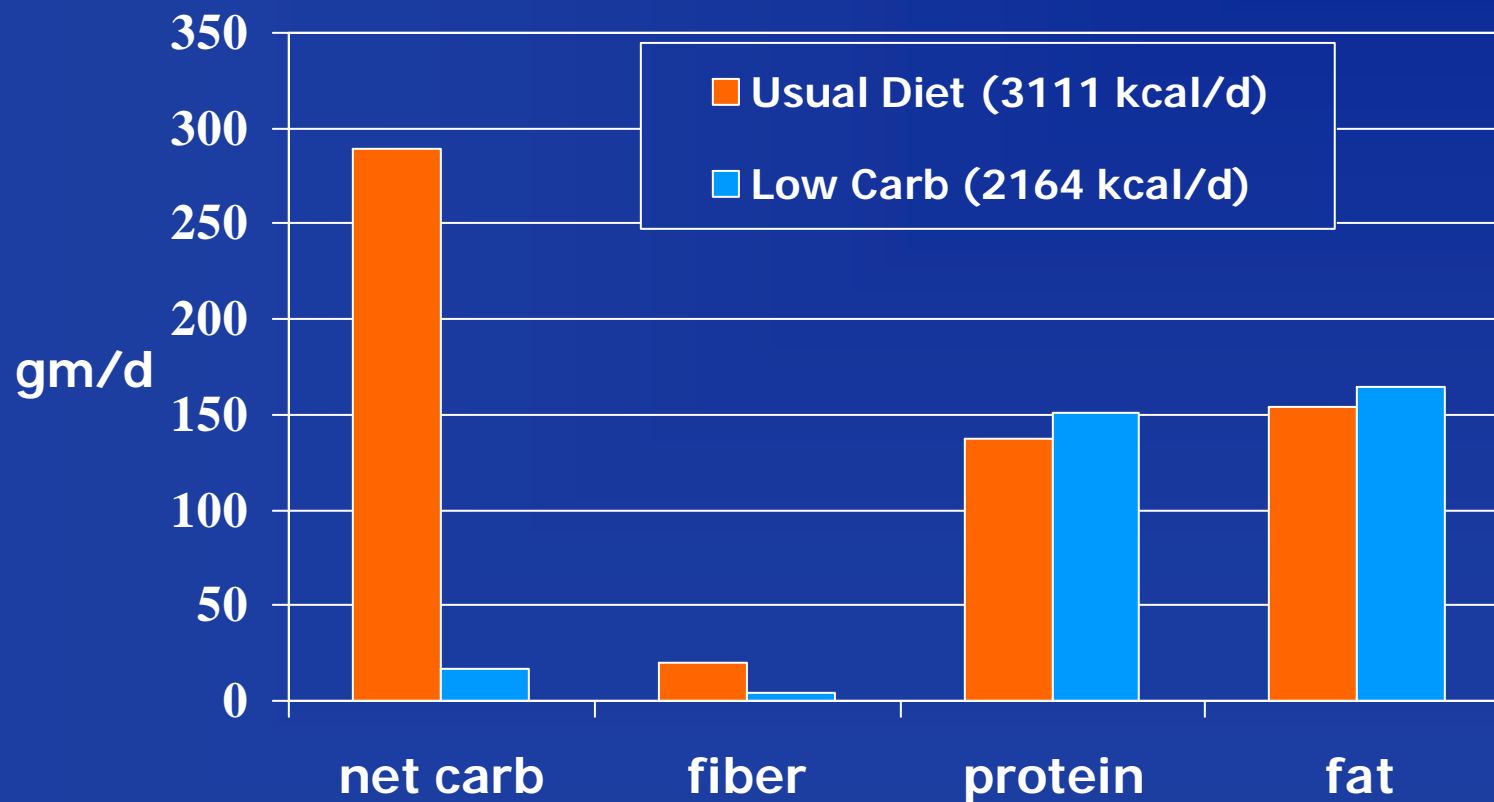
- Inefficiency of protein and fat processing leads to extra energy loss <sup>2</sup>
- Lipolysis is maintained despite calorie excess state because glycerol from fat is needed as a gluconeogenic precursor <sup>3</sup>

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.

# 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

## 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

Dansinger ML et al. JAMA 2005;293:43-53.

## 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

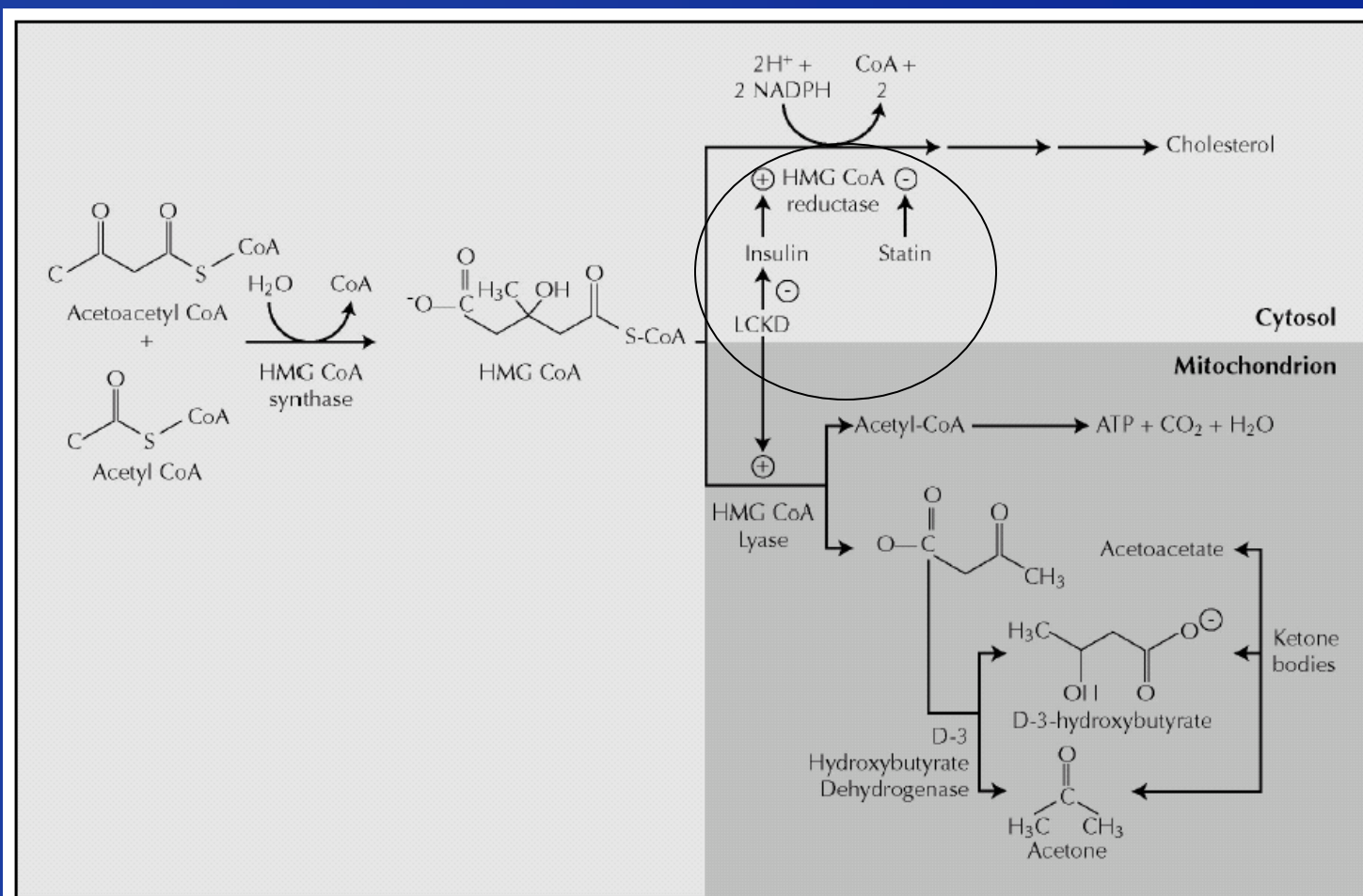
Gardner CD et al. JAMA 2007;297:969-977.

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

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

Gardner CD et al. JAMA 2007;297:969-977.

# Does Insulin Reduction Explain the Lack of Rise in Serum Cholesterol?



**Figure 2.** Potential biochemical mechanism of cholesterol reduction of a low-carbohydrate ketogenic diet (LCKD). (ATP—adenosine triphosphate; HMG CoA—3-hydroxy-3-methylglutaryl coenzyme A.)

Kennedy AR et al. A high fat, ketogenic diet induces a unique metabolic state in mice. *Am J Physiol Endocrinol Metab* 2007, February 13.

# Relationship Between Large VLDL and Small LDL

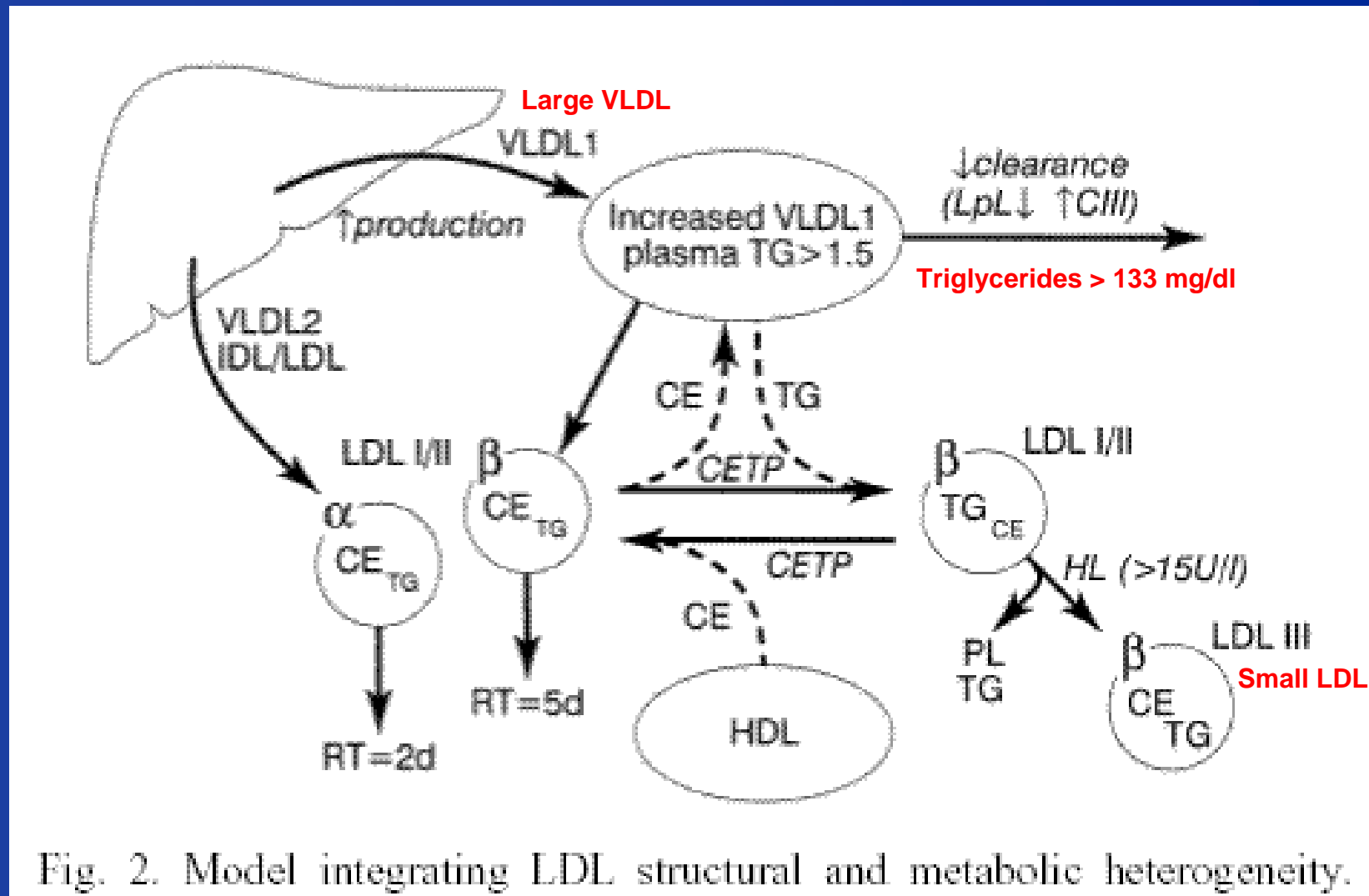


Fig. 2. Model integrating LDL structural and metabolic heterogeneity.

Packard C et al. Int J Card 2000;74:S17–S22.

# Dietary Carbohydrate, Large VLDL and Small LDL

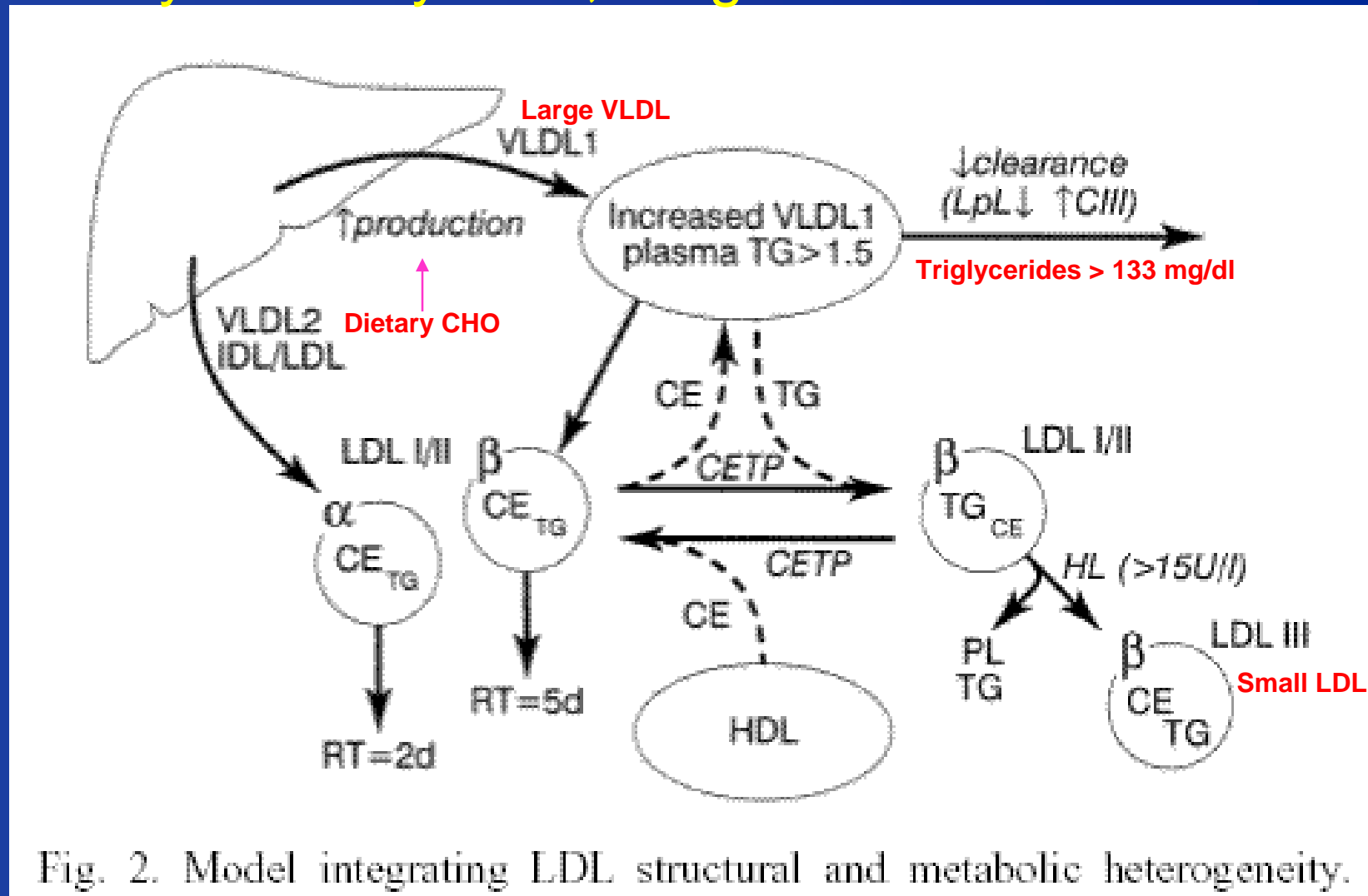


Fig. 2. Model integrating LDL structural and metabolic heterogeneity.

Volek JS, Feinman RD. Carbohydrate restriction improves the features of Metabolic Syndrome. Metabolic Syndrome may be defined by the response to carbohydrate restriction. Nutrition & Metabolism 2005, 2:31.

## Diabetic Diet Recommendation in the Pre-Insulin Era (1914-1921)

“Quantity of food required by a severe diabetic patient  
weighing 60 kilograms”\*

<u>Food</u>		<u>Calories</u>
Carbohydrate	10 grams	40
Protein	75 grams	300
Fat	150 grams	1,350
Alcohol	15 grams	<u>105</u>
		1,795

“Strict diet”: Meats, poultry, game, fish, clear soups, gelatin,  
eggs, butter, olive oil, coffee, tea

\* Osler W, McCrae T. The Principles and Practice of Medicine. NY: Appleton and Co., 1923.  
Allen FM. Protein diets and undernutrition in treatment of diabetes. JAMA 1920;74:571-577.  
Newburgh LH, Marsh PL. The use of a high fat diet in the treatment of diabetes mellitus.  
Arch Int Med 1921;27:699-705.

## Low Carbohydrate Diets for Type 2 Diabetes Clinical Series / Pilot Studies

<u>Reference</u>	<u>n</u>	<u>Weight</u> kg	<u>CHO</u>	<u>Follow-up</u>	<u>Pre</u> <u>HA1c</u> %	<u>Post</u> <u>HA1c</u> %	<u>Wt Diff</u> %
Vernon 2003	14	123.2	~10%	8 months	10.0	5.9	-9.7
O'Neill 2003	20	82	~10%	10 months	8.4	5.8	-6.7
Nielsen 2005	16	100	~20%	12 months	8.0	6.6	-11.9
Yancy 2005	28	131.4	~7%	16 weeks	7.5	6.3	-6.6

Vernon MC et al. Metabolic Syndrome and Related Disorders 2003;1:233-238.

O'Neill DF, Bernstein R et al. Met Syn Rel Dis 2003;1:291-298.

Nielsen JV et al. Upsala J Med Sci 2005;109:179-184.

Yancy WS Jr. et al. Nutrition & Metabolism 2005;2:34.

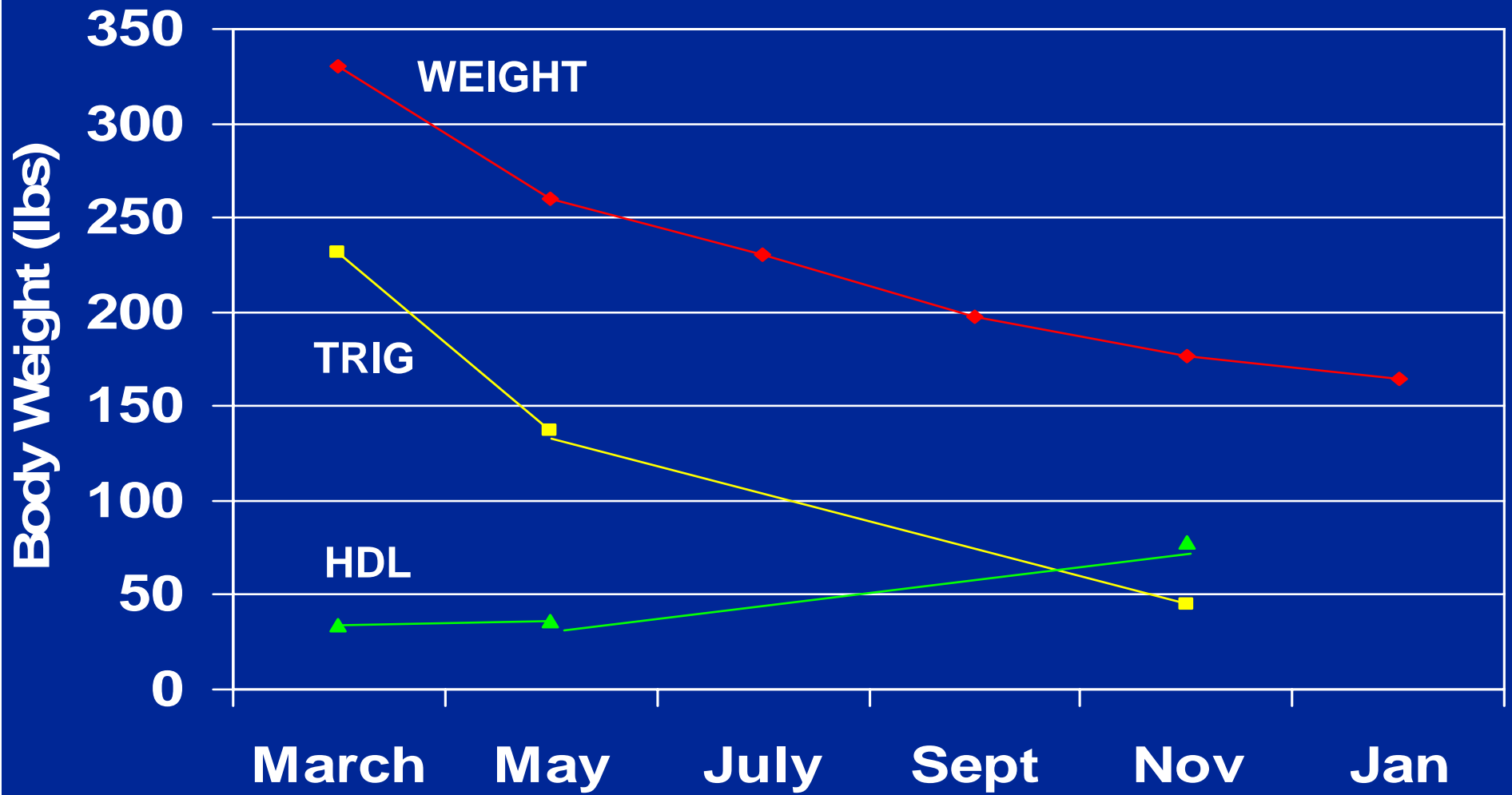






Spironolactone, coumadin d/c'd

CPAP d/c'd



# Diets, Carbohydrates and Calories

CHO Grams/day

300

Typical American Diet

Very Low Fat Diet

200

Low Glycemic Index Diet

Mediterranean Diet

Zone Diet

100

Atkins Maintenance

50

Low Carbohydrate Ketogenic Diet

Diabetes Solution

(Ketonuria)

Atkins Induction

20

Protein Power

0

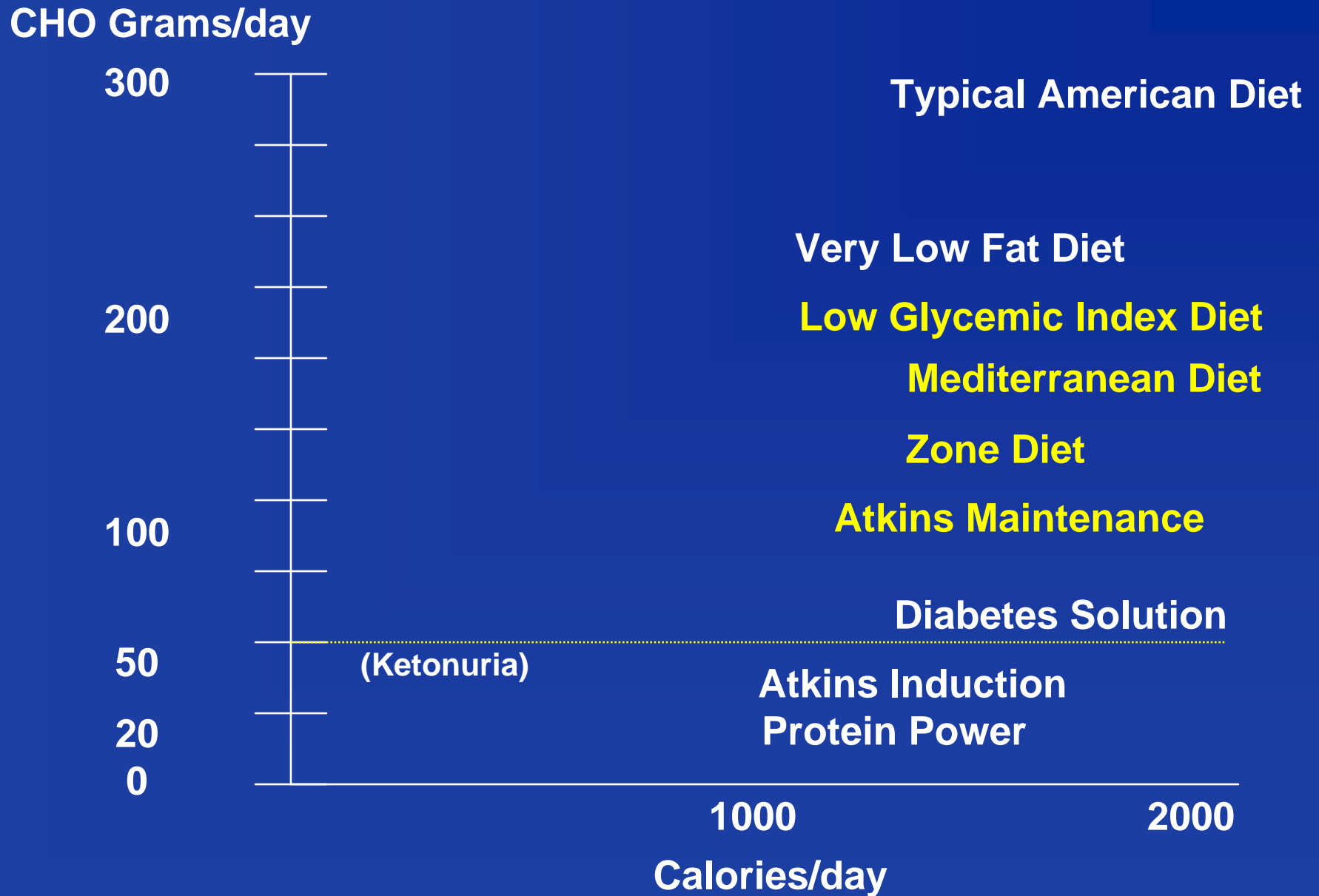
1000

2000

Calories/day



# Diets, Carbohydrates and Calories



# 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
- Longer term studies of the low carbohydrate diet approach are ongoing