THE ATKINS NUTRITIONAL APPROACH TO OBESITY AND DIABETES

THE ALTERNATE METABOLIC PATHWAY: EVIDENCE BEHIND CONTROLLED CARBOHYDRATE PRINCIPLES

Robert C. Atkins, M.D.

What Is “The Atkins Nutritional Approach™?”

- Controlling carbohydrate intake and converting the body to an alternate metabolic pathway will promote weight loss, allow for a lifetime of effective weight management, promote good health and be effective in preventing specific disease.

The Most Direct System for Weight Loss

Switch the Entire Metabolism From Glucose-Burning to Primarily Fat-Burning

- This lipolytic pathway is the second of the body's two primary pathways for energy. The human body readily produces all the enzymes involved in fat-mobilization (lipolysis).
- When fat is being mobilized, it neither accumulates nor deposits.
- Large, but not excessive, quantities of non-carbohydrate foods may be consumed; they do not inhibit fat mobilization.

Rationale: Controlled Carbohydrate Lifestyle

- Stored fat is the body's backup fuel system.
- The human body cannot store more than a two-day supply of carbohydrate.
- In the absence of dietary carbohydrate, fat becomes the primary energy fuel.
- The steady burning of fat produces more energy and appetite is dramatically reduced.

Misconceptions About The Atkins Nutritional Approach™

- Ketogenic diets eliminate fruit, vegetables and all other carbohydrates.
- High-protein eating regimens cause kidney or liver damage.
- Weight loss on controlled carbohydrate eating plans is caused by calorie restriction.
- Controlled carbohydrate programs promote cardiac risk.
- Controlled carbohydrate programs are short-term only, and not suitable for long-term adherence.

Misconceptions About The Atkins Nutritional Approach™(cont'd)

- Controlled carbohydrate plans do not promote fat loss, but cause loss of protein/lean body mass and total body water.
- Glucose is the only fuel the brain can use.
- Controlled carbohydrate eating regimens are deficient in vitamins and minerals.
- Weight maintenance is impossible on a controlled carbohydrate eating program.
- Ketogenic diets are dangerous.

The Alternative Metabolic Pathway: Critical in Managing Diabetes & Obesity

1. Stabilizes insulin resistance.
2. Controls hyperinsulinism.
3. Normalizes blood sugar.
4. Burns fat as energy.
5. Reduces appetite as an outcome of lipolysis/ketosis.
6. Improves clinical parameters (including lipid profile).

Stages of Type II Diabetes

Stage 1- Insulin Resistance (IR)

Stage 2 - Hyperinsulinism (HI)

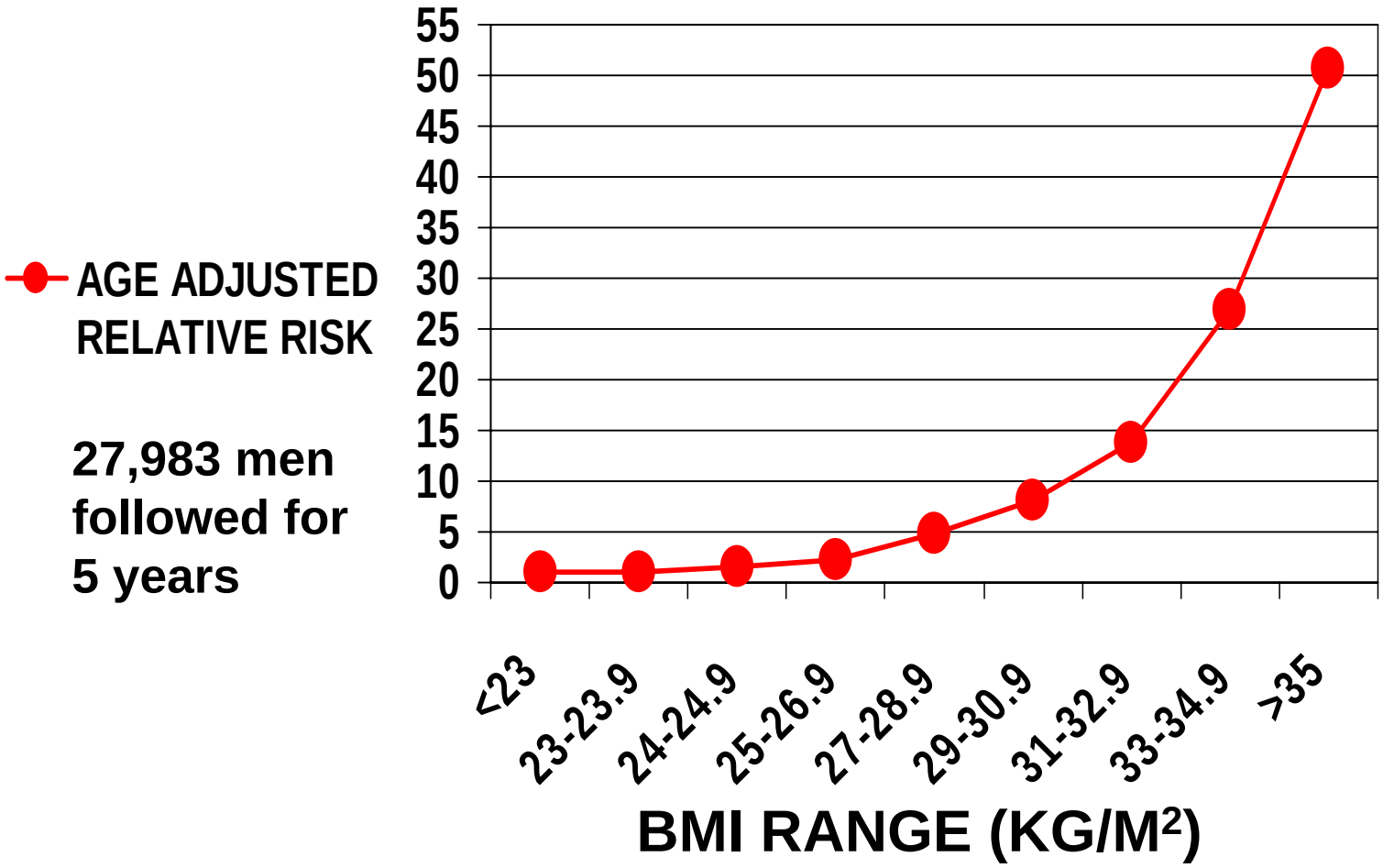
Stage 3 - IR + HI with abnormal glucose tolerance test

Stage 4 - Type II Diabetes with high insulin

Stage 5 - Type II Diabetes with low insulin

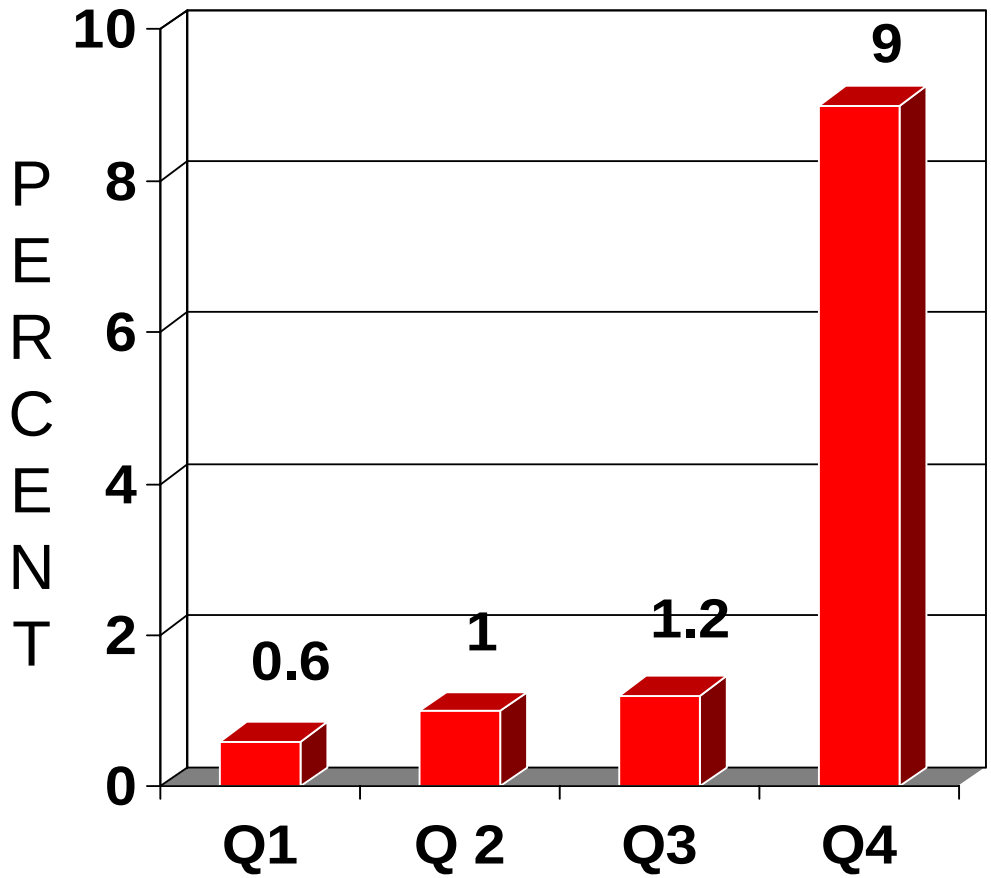
DeFronzo, R.A., Bonadonna, R.C., Ferrannini, E., “Pathogenesis of NIDDM: A Balanced Overview,” *Diabetes Care*, 15(3), 1992, pages 318-368.

Risk of Diabetes According to Body Mass Index (BMI)



Chan, J.M., Rimm, E.B., Colditz, G.A., et al., "Obesity, Fat Distribution, and Weight Gain as Risk Factors for Clinical Diabetes in Men," *Diabetes Care*, 17(9), 1994, pages 961-969.

Incidence of Impaired Glucose Tolerance (IGT) Pre-Diabetes or Type II Diabetes Based on Plasma Insulin Response to a Glucose Challenge



- **Incidence of IGT (pre-diabetes) or Type II diabetes**

647 factory workers followed for 15 years

Zavaroni, I., Bonini, L., Gasparini, P., et al., "Hyperinsulinemia in a Normal Population as a Predictor of Non-Insulin-Dependent Diabetes Mellitus, Hypertension, and Coronary Heart Disease: The Barilla Factory Revisited," *Metabolism*, 48(8), 1999, pages 989-994.

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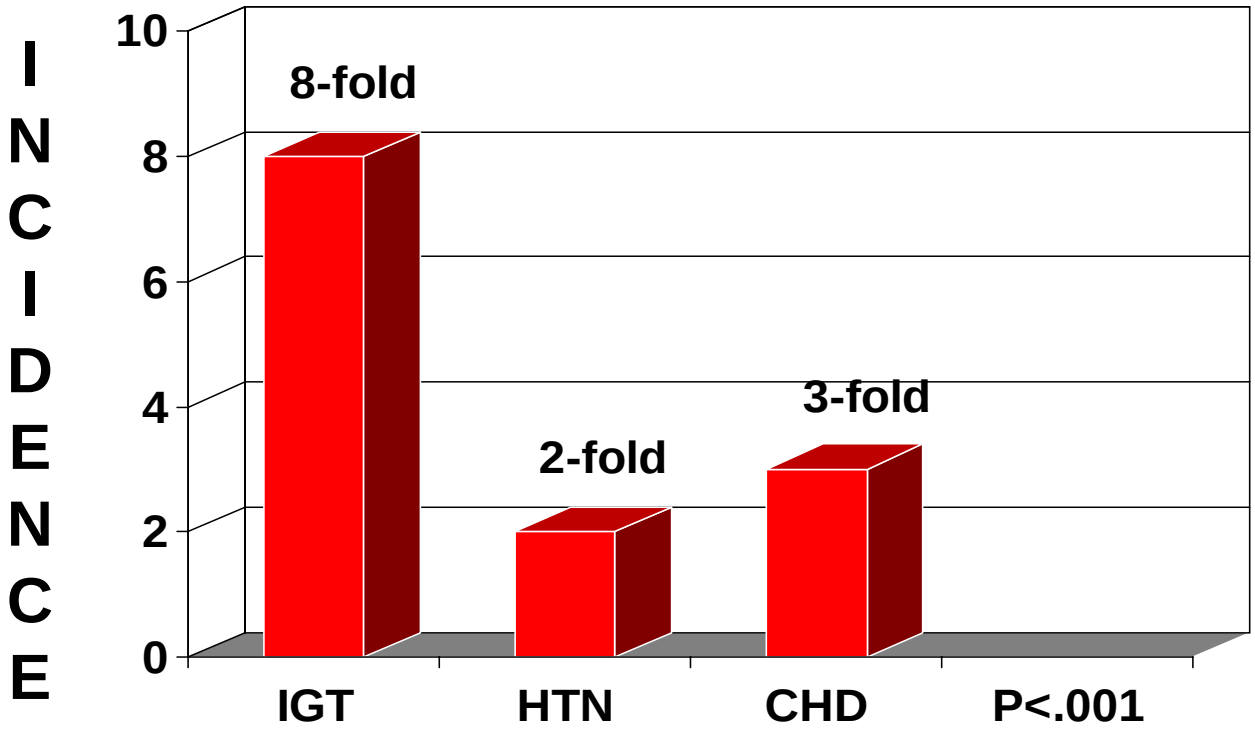


647 factory workers followed for 15 years

IGT = Impaired Glucose Tolerance

HTN = Hypertension

CHD = Coronary Heart Disease

Highest 25% with highest insulin responses

Zavaroni, I., Bonini, L., Gasparini, P., et al., "Hyperinsulinemia in a Normal Population as a Predictor of Non-Insulin-Dependent Diabetes Mellitus, Hypertension, and Coronary Heart Disease: The Barilla Factory Revisited," *Metabolism*, 48(8), 1999, pages 989-994.

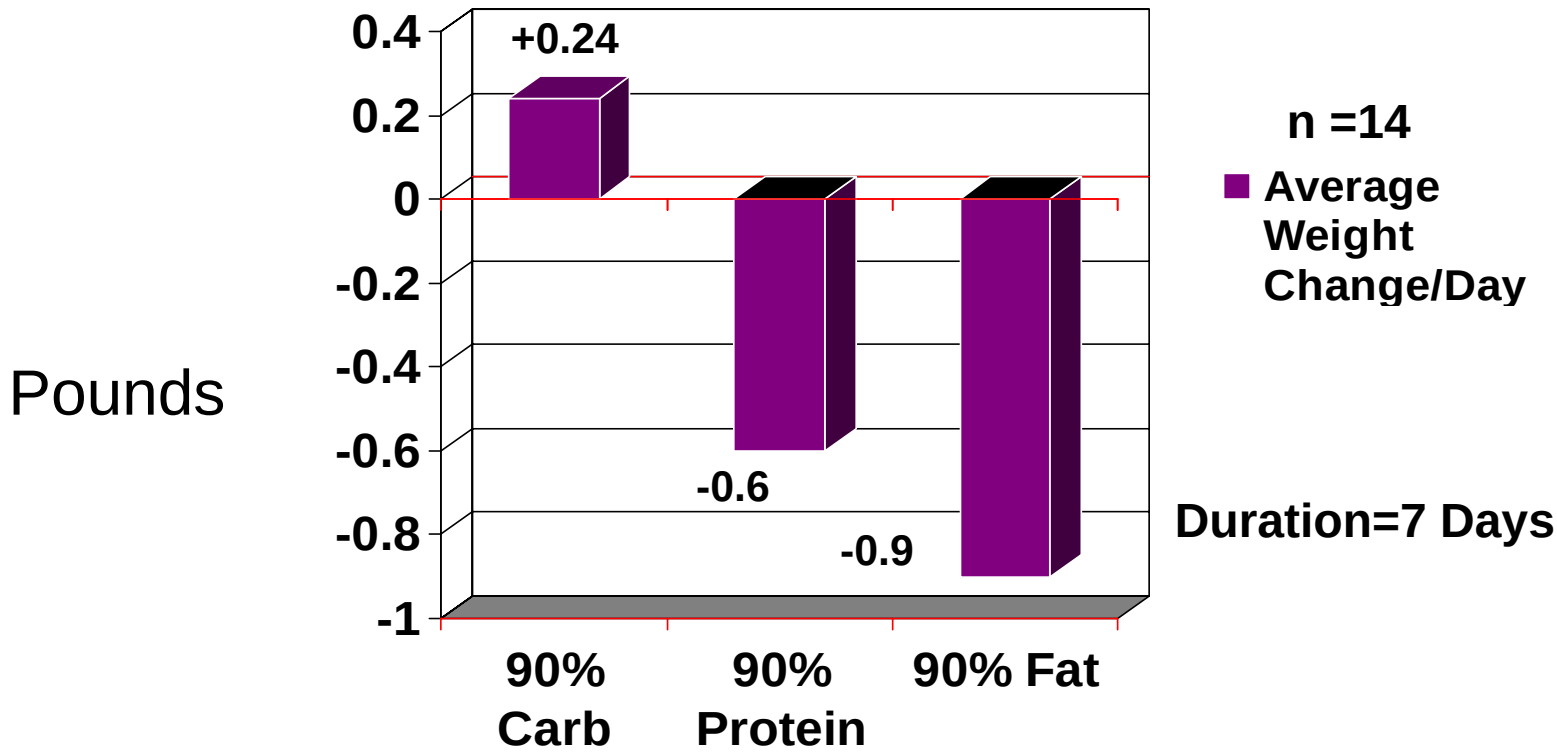
High-Fat Controlled Carbohydrate Program Improves Glycemic Control in Type II Diabetes Mellitus

157 Subjects Studied

	Control	*12 mos*
BMI	33.4	32.1
Chol (mg/dl)	231	199
Trig (mg/dl)	229	182
HDL (mg/dl)	44	47
LDL (mg/dl)	133	105
HgA1C Index	3.34	0.96

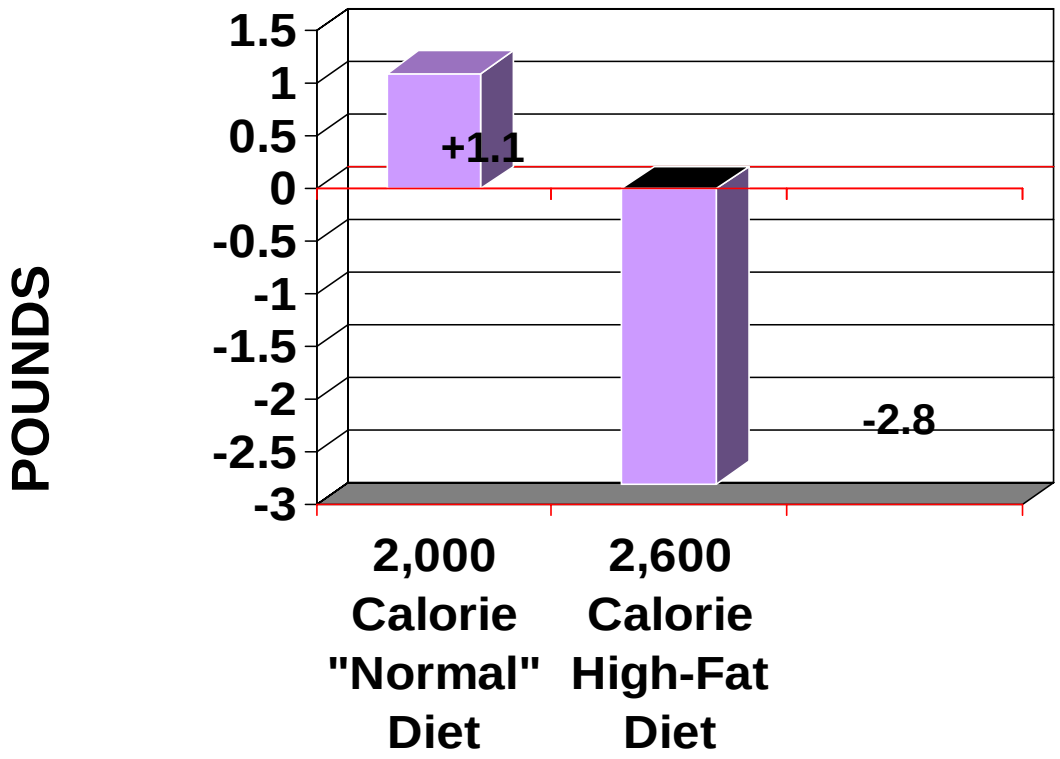
Hays, J.H., Armstrong, D.W., Brietzke, S.A., "High-Fat, Carbohydrate Restricted Diet Improves Glycemic Control in Type 2 Diabetes Mellitus," 2000, Abstract of the 81st Annual Meeting of the Endocrine Society.

Daily Weight Changes on 1,000-Calorie Diets of Different Composition



Kekwick, A., Pawan, G.L.S., "Calorie Intake in Relation to Body-Weight Changes in the Obese," *The Lancet*, July 28, 1956, pages 155-161.

Weight Changes With “Normal” 2,000-Calorie and High-Fat 2,600-Calorie Diets



n =6

Average Weight Change

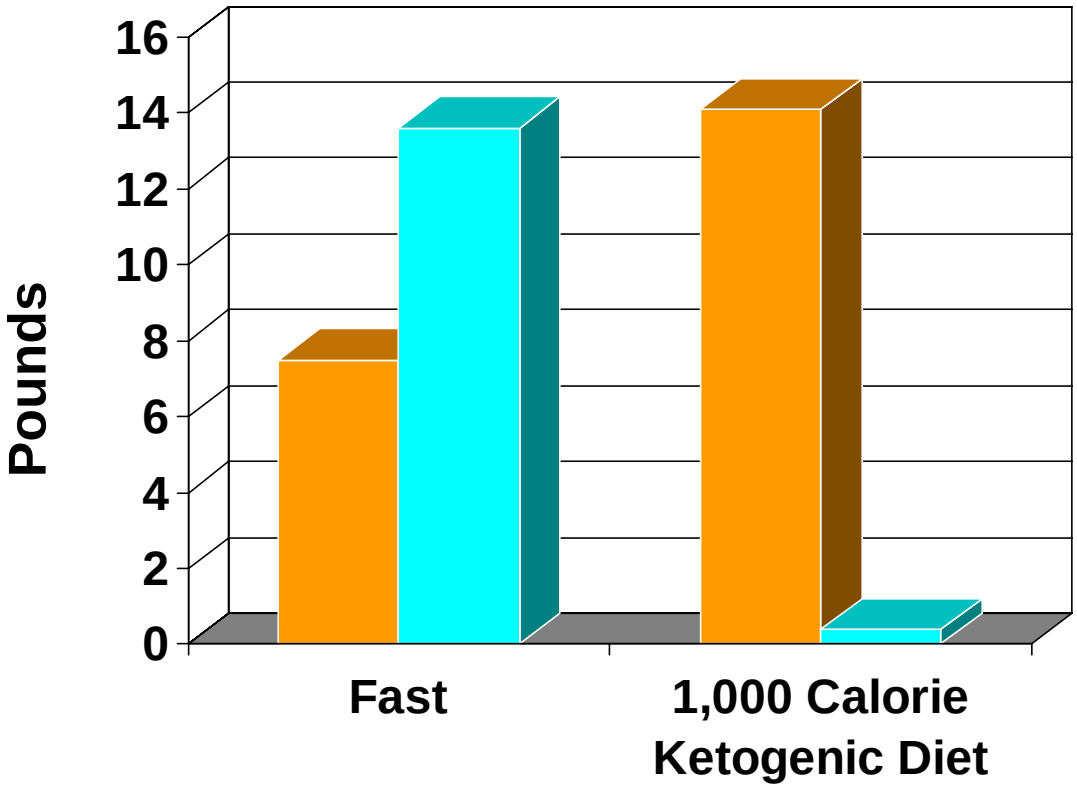
Based on Average

2,000 Cal= 7.2 days

2,600 Cal=8.4 days

Kekwick, A., Pawan, G.L.S., "Calorie Intake in Relation to Body-Weight Changes in the Obese," *The Lancet*, July 28, 1956, pages 155-161.

Metabolic Effects of Various Diets



Body Fat Lost

Lean Body Mass

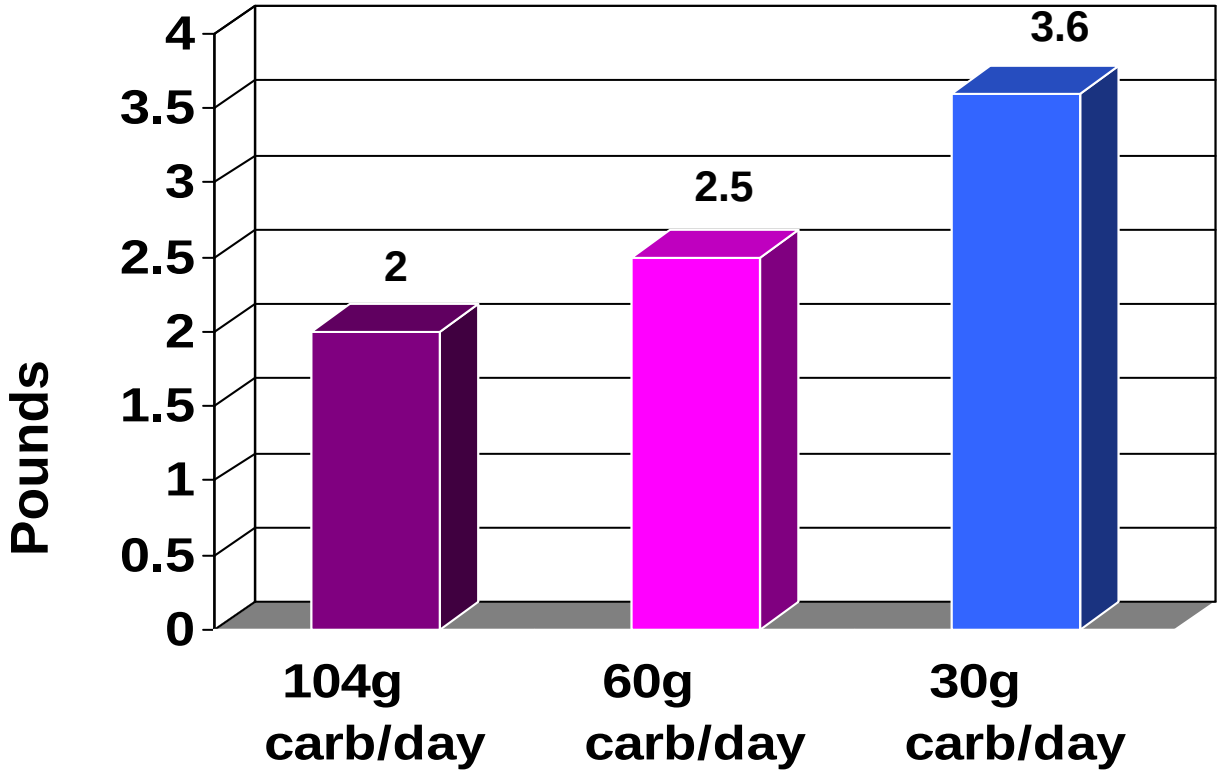
10 days on each diet

Fast = No calories

Ketogenic diet =
4% Carbohydrate
14% Protein
82% Fat

Benoit, F.L., Martin, R.L., Watten, R.H., "Changes in Body Composition During Weight Reduction in Obesity: Balance Studies Comparing Effects of Fasting and a Ketogenic Diet," *Annals of Internal Medicine*, 63(4), 1965, pages 604-612.

Pounds of Body Fat Lost Per Week on Varying Grams of Carbohydrate Intake



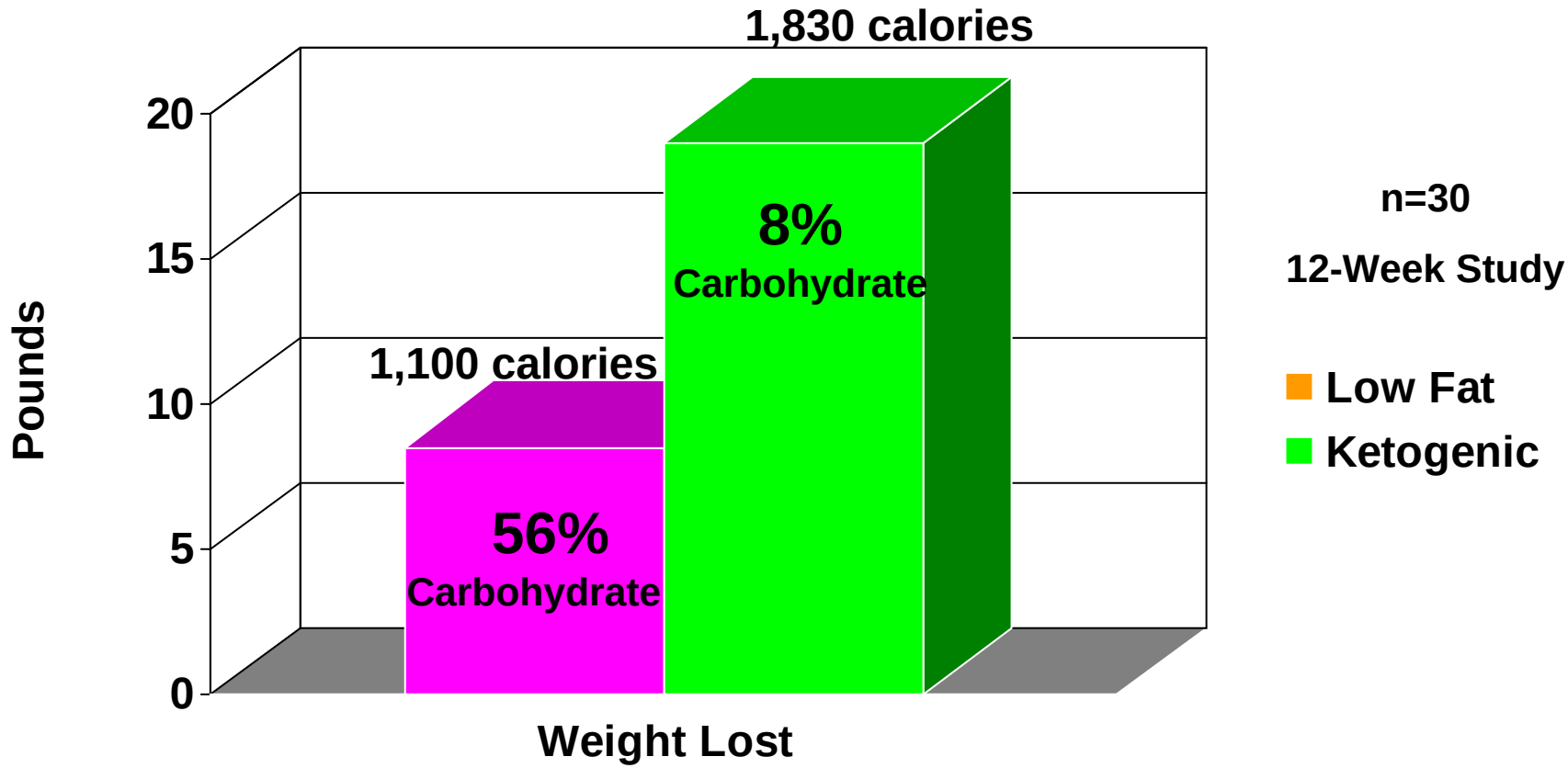
9-Week Study

n= 8 Obese Young Men

1,800 Calorie Diet

Young, C.M., Scanlan, S.S., Im, H.S., et al., "Effect on Body Composition and Other Parameters in Obese Young Men of Carbohydrate Level of Reduction Diet," *The American Journal of Clinical Nutrition*, 24, 1971, pages 290-296.

Comparison of Low-Fat Diet Therapy With Controlled Carbohydrate, Ketogenic Approach in Obese Adolescents



Sondike, S.B., Copperman, N.M., Jacobson, M.S., "Low Carbohydrate Dieting Increases Weight Loss but not Cardiovascular Risk in Obese Adolescents: A Randomized Controlled Trial," *Journal of Adolescent Health*, 26, 2000, page 91.

The Role of Ketones

- **Fat delivers energy via ketones just as carbohydrate delivers energy via glucose.**
- **Enzymes are present within all cells, including the brain, to convert ketones into fuel.**

Magnitude of Ketogenic Effects (Physiological Ketosis Versus Diabetic Ketoacidosis)

Condition	Quantity of Ketones
Fed State:	0.1 mmol/L
Overnight Fast:	0.3 mmol/L
Ketogenic Diet:	1-3 mmol/L
>20 Days Fasting:	10 mmol/L
Uncontrolled Diabetes:	>25 mmol/L

The Human Metabolic Response to Chronic Ketosis Without Caloric Restriction: Physical and Biochemical Adaptation

Summary:

"In view of the tests done to screen for ill effects of the EKD, the remarkably benign nature of a diet providing 85% of calories as fat is notable. After four weeks there was no measurable impairment of hepatic, renal, cardiac, or hematopoietic function. The serum uric acid level, elevated by competition from ketone bodies for excretion, was almost back to normal by that time."

Phinney, S.D., Bistrian, B.R, Wolfe R.R., et al., "The Human Metabolic Response to Chronic Ketosis Without Caloric Restriction: Physical and Biochemical Adaptation," *Metabolism*, 32(8), 1983, pages 757-768.

Brain Adaptation to Ketosis

- "β-hydroxybutyrate and acetate replaced glucose as the predominant fuel for brain metabolism."

- No deleterious effects were observed.

Owen, O.E., Morgan, A.P., Kemp, H.G., et al., "Brain Metabolism During Fasting," *Journal of Clinical Investigation*, 46(10), 1967, pages 1589-1595.

Weight Change Using High-Carbohydrate Diet and High-Fat Nutritional Approach

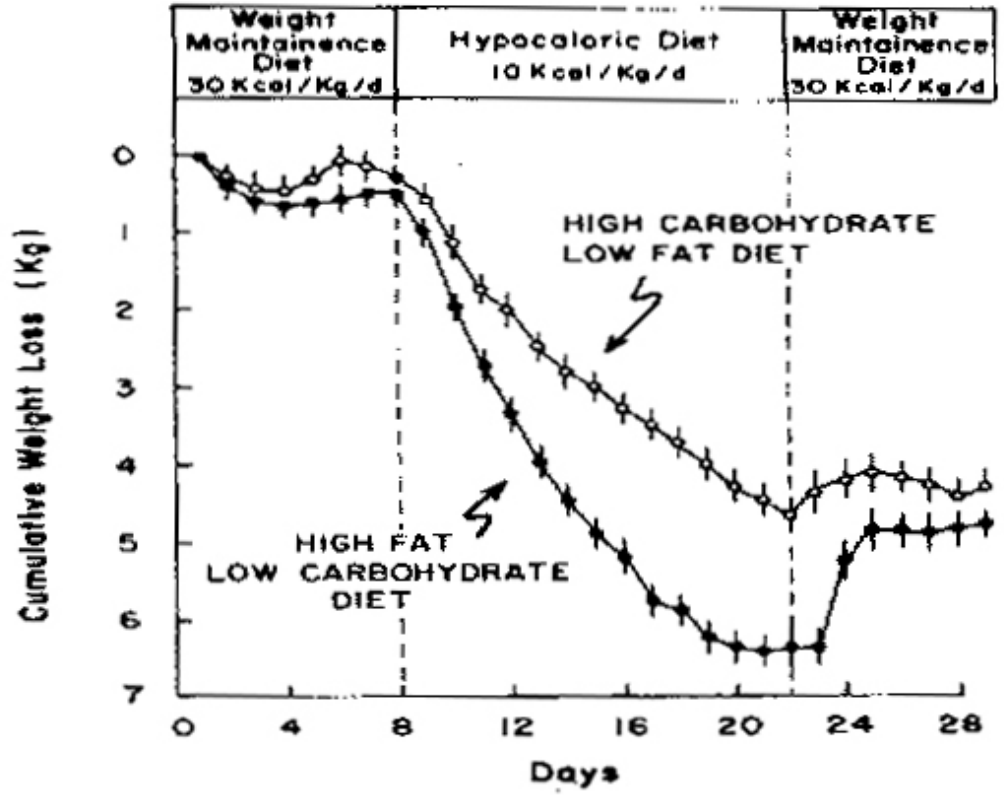


FIG. 1. Weight loss during weight maintenance dietary period, hypocaloric diet period, and reinstitution of weight maintenance dietary period. Mean ± SEM (n = 10).

14-day randomized reduction diet:

High-Fat diet:
70% fat
10% carbohydrate

High-Carbohydrate diet:
10% fat
70% carbohydrate

Both:
1/3 usual caloric intake

Lewis, S.B., Wallin, J.D., Kane, J.P., et al., "Effect of Diet Composition on Metabolic Adaptations to Hypocaloric Nutrition: Comparison of High Carbohydrate and High Fat Isocaloric Diets," *The American Journal of Clinical Nutrition*, 30(2), 1977, pages 160-170.

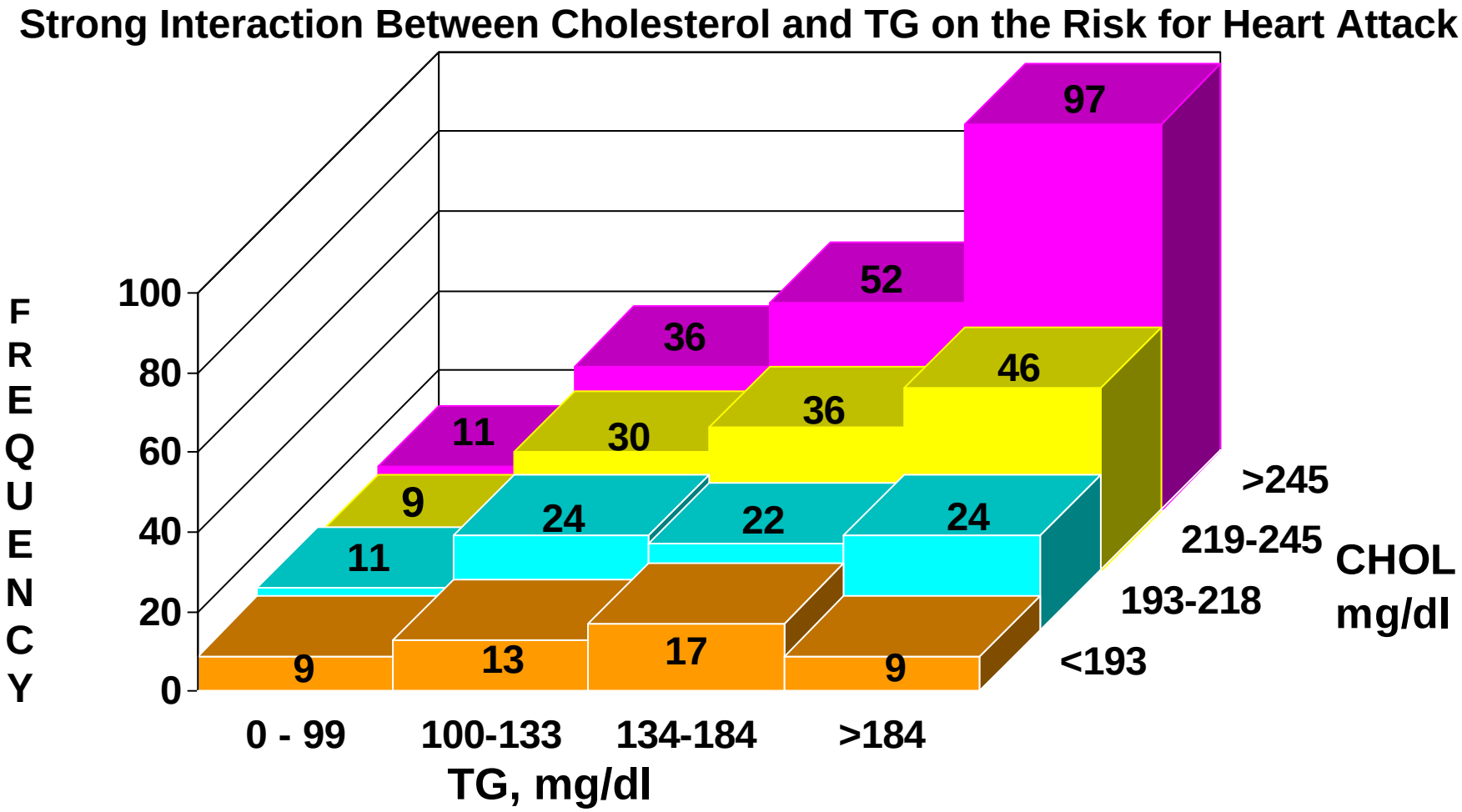
Conclusion From Oakland Naval Study

"Since greater ketonemia was found in the high fat-low carbohydrate diet in association with similar circulating FFA levels, as in the high carbohydrate-low fat diet, a switch in the intrahepatic metabolism of FFA away from triglyceride synthesis and toward ketone body production could explain both the lowered serum triglyceride levels and higher ketone body levels." **(Note: FFA = free fatty acid)**

Ketonemia signifies fat is being used as fuel.
Triglyceridemia signifies fat is being stored.

Lewis, S.B., Wallin, J.D., Kane, J.P., et al., "Effect of Diet Composition on Metabolic Adaptations to Hypocaloric Nutrition: Comparison of High Carbohydrate and High Fat Isocaloric Diets," *The American Journal of Clinical Nutrition*, 30(2), 1977, pages 160-170.

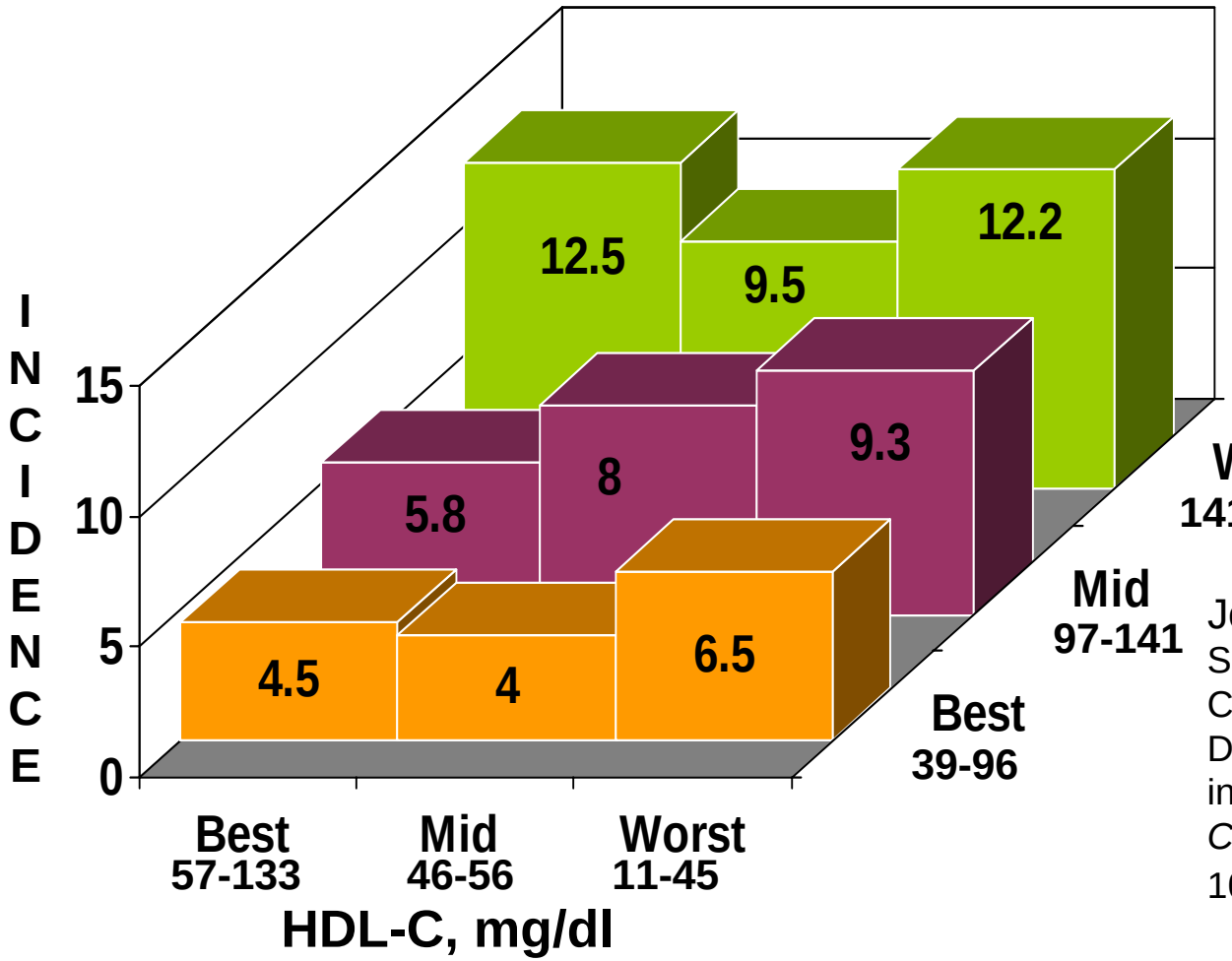
Frequency of Heart Attacks by Cholesterol and Triglyceride (TG)



Stavenow, L., Kjellstrom, T., "Influence of Serum Triglyceride Levels on the Risk for Myocardial Infarction in 12,510 Middle Aged Males: Interaction with Serum Cholesterol." *Atherosclerosis*, 147, 1999, pages 243-247.

The Copenhagen Male Study

2,906 Men Without Heart Disease: An 8-Year Follow-up Study



Fasting triglycerides (TG) is a stronger indicator of ischemic heart disease (IHD) than other major risk factors including HDL-cholesterol.

Jeppesen, J., Hein, H.O., Suadicani, P., et al., "Triglyceride Concentration and Ischemic Heart Disease: An Eight-Year Follow-up in the Copenhagen Male Study," *Circulation, 97(11),* 1998, pages 1029-1036.

Relative Risk of Heart Attack
Quartile of Log Triglyceride Level/HDL Level

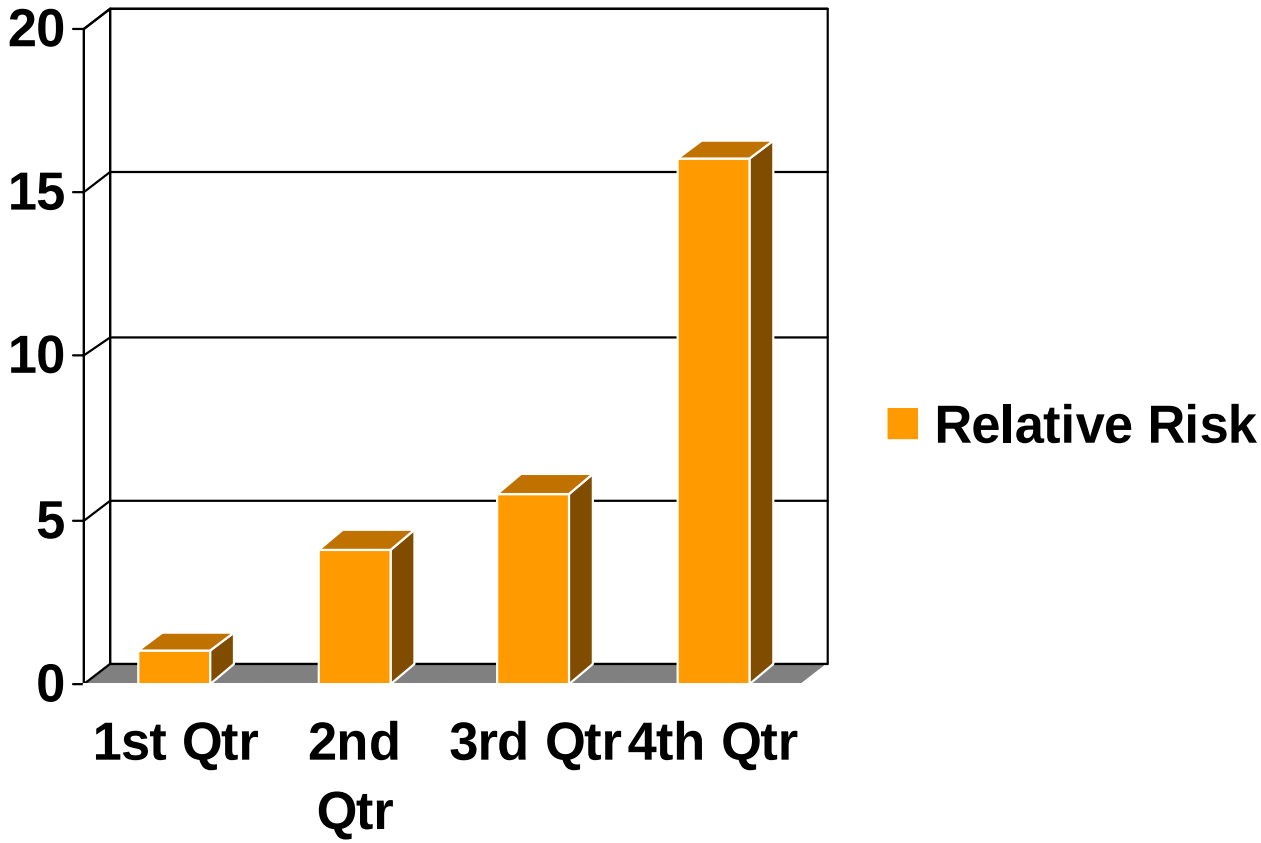
Average Triglyceride Levels

1st Q=70.1

2nd Q=108.5

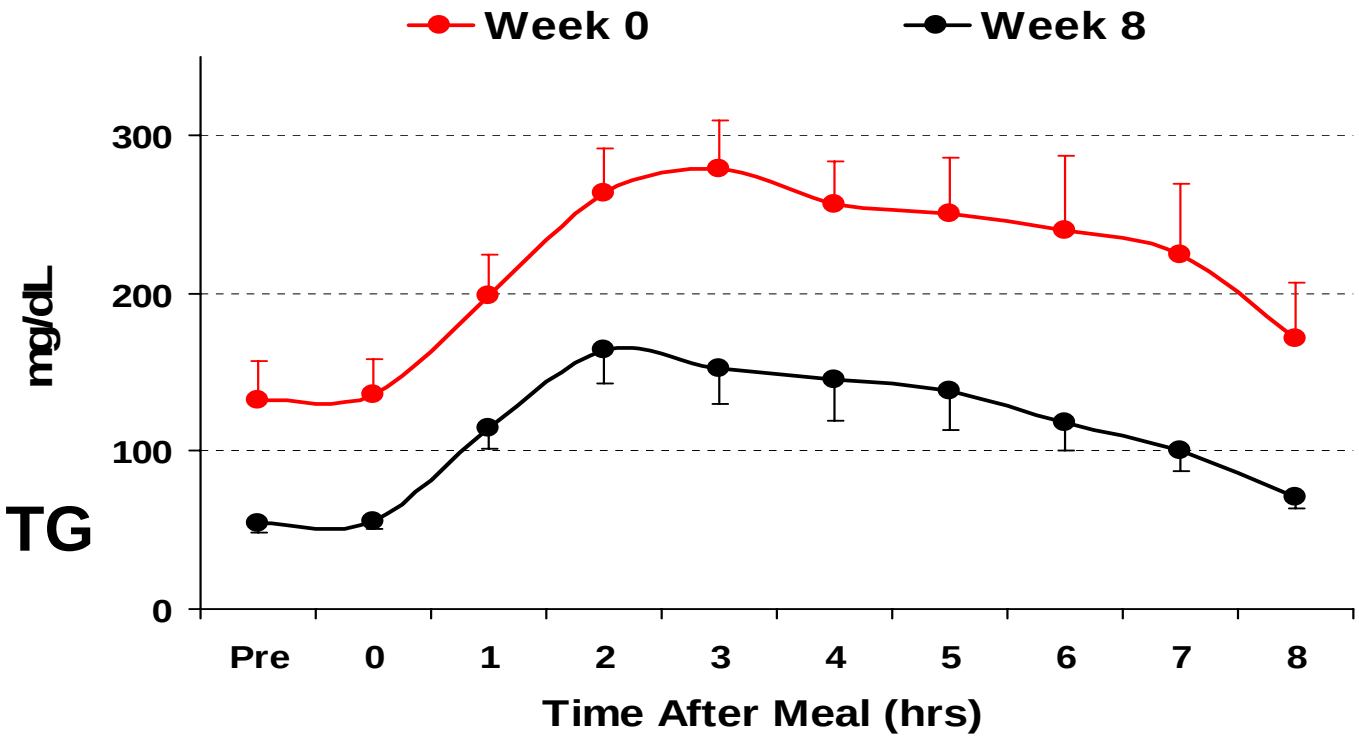
3rd Q=138.7

4th Q=278.9



Gaziano, J.M., Hennekens, C.H., O'Donnell, C.J. et al., "Fasting Triglycerides, High-Density Lipoprotein, and Risk of Myocardial Infarction," *Circulation*, 96(8), 1997, pages 2520-2525.

Postprandial Triglyceride (TG) Responses to a High-Carbohydrate Test Meal Following A Ketogenic Diet



10 men
Ketogenic diet:
Calories from fat: 65-70%
Calories from carbohydrate: 5-10%

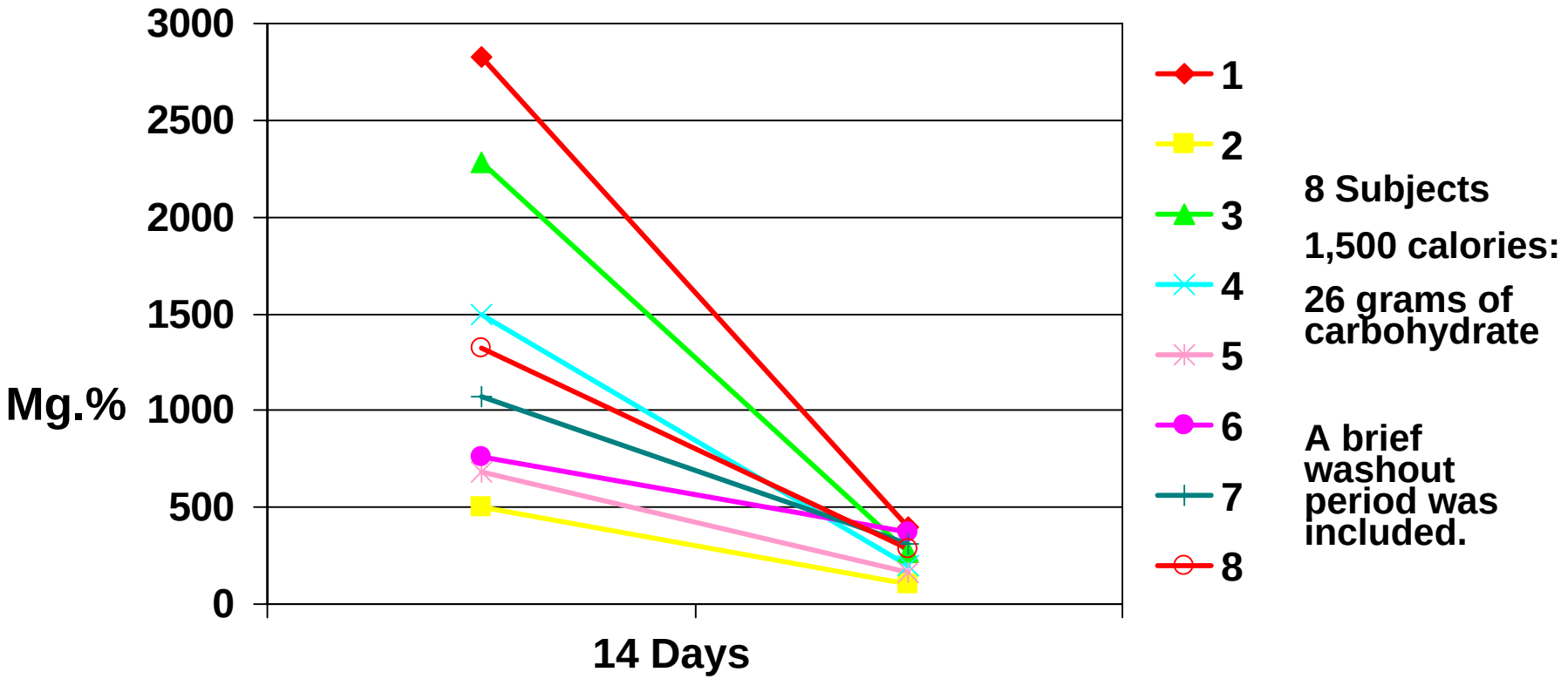
Volek, J.S., Gómez, A.L., Kraemer, W.J., "Fasting Lipoprotein and Postprandial Triacylglycerol Responses to a Low-Carbohydrate Diet Supplemented With N-3 Fatty Acids," *Journal of the American College of Nutrition*, 19(3), 2000, pages 383-391.

10-Day Comparison Between 40% and 60% Dietary Carbohydrate

- "Fasting plasma TG levels were significantly elevated on the 60% carbohydrate diet, and HDL-cholesterol concentrations were significantly decreased."
- "Plasma insulin and triglyceride responses to the meal tolerance test during 60% carbohydrate diet were significantly elevated."
- "These results indicate that high-carbohydrate diets lead to changes in insulin, TG, and HDL-cholesterol concentrations which have been associated with an increase incidence of CAD."

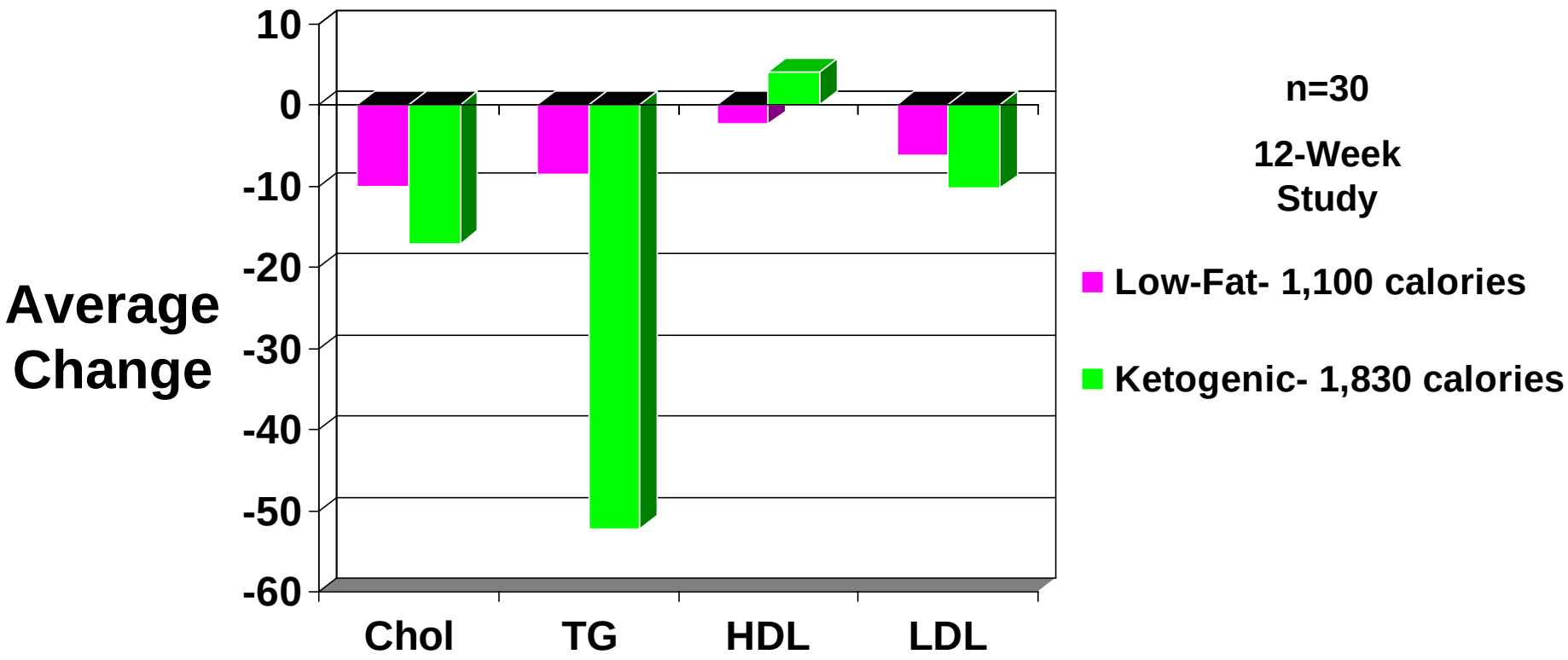
Coulston, A.M., Liu, G.C., Reaven, G.M., "Plasma Glucose, Insulin and Lipid Responses to High-Carbohydrate Low-Fat Diets in Normal Humans," *Metabolism*, 32(1), 1983, pages 52-56.

Triglyceride Changes on a Controlled Carbohydrate, High-Fat Regimen



Reissell, P.K., Mandella, P.A., Poon-King, T.M.W., et al., "Treatment of Hypertriglyceridemia," *The American Journal of Clinical Nutrition,*19, 1966, pages 84-98.

Comparison of Conventional Low-Fat Diet With a Non-Energy Restricting, Controlled Carbohydrate, Ketogenic Program in Obese Adolescents



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20-25 Gram Carbohydrate Nutritional Approach: Effect on Serum Lipids

Variables *(mg/dl)*	Baseline *mean (SD)*	Week 16 *mean (SD)*	*% Change*
Cholesterol	212.0 (34.4)	201.4 (40.5)	- 5.6
LDL	132.9 (28.8)	129.8 (37.5)	- 0.02
HDL	53.4 (13.6)	55.9 (12.4)	+ 8.8*
Chol/HDL	4.2 (1.3)	3.7 (1.6)	- 16.7*
Triglycerides	122.3 (59.6)	78.6 (35.1)	- 42.6*

***n=40* overweight males and females 6 month prospective clinical trial**
*** Significant change, comparing change from baseline to week 16**

Yancy, W. S., Bakst, R., Bryson, W., et al., "Effects of a Very-Low-Carbohydrate Diet Program Compared With a Low-Fat, Low-Cholesterol, Reduced Calorie Diet ," October 7, 2001, North American Association for the Study of Obesity Annual Meeting, Quebec City, Canada.

The Controlled Carbohydrate Advantage for Long-Term Weight Control

- Provides a metabolic advantage:
  - More fat is burned, than on other weight loss programs (calorie for calorie).
- Acts as an appetite suppressant.
- Suitable for long-term adherence:
  - Increased satiety
  - No calorie counting
  - Low-fat food choices not necessary
  - Abundant in basic nutrients

The Controlled Carbohydrate Advantage for Long-Term Weight Control

- Physical improvements noted:
  - Improved lean body mass to fat mass ratio.
  - Weight loss maintenance without negative side-effects.
  - Increased capacity to exercise.
- Prevents/corrects hyperinsulin-related conditions:
  - Diabetes
  - Hypertension
  - Cardiac risk factors (high triglycerides, low HDL)

The Controlled Carbohydrate Advantage for Long-Term Weight Control

- Other benefits observed in clinical setting:
  - Less need for sleep
  - Improvement in gastro-intestinal symptoms (irritable bowel syndrome, gastro-esophageal reflux

    disease, bloating, flatulence)
  - Diminished/eliminated cravings for sweets
  - Improvement in mood
  - Increase in energy

The Alternative Metabolic Pathway

- When the intake of digestible carbohydrate is sufficiently restricted, the body converts from the metabolic pathway of burning carbohydrate to burning fat as the primary energy source.
- Fat, rather than carbohydrate, is used to provide energy.
- This results in weight loss, glucose and lipid control.

Evaluation of the Atkins Nutritional Approach™: A Randomized Control Trial (12 Weeks)

	Conventional Diet (n=14)	Atkins (n=19)	Significance
	% change	% change	
Weight	-3.4 ± 4.3	-8.6 ± 3.7	.001*
Total Cholesterol	-9.7 ± 10.2	+4.9 ± 15.2	.004*
LDL-Cholesterol	-14.6 ± 14.5	+8.8 ± 21.1	.001*
HDL-Cholesterol	-1.8 ± 14.4	+9.8 ± 20.2	.069
Triglycerides	-2.3 ± 31.7	-19.0 ± 27.8	.089

*** significant change**

Foster, G.D., Wyatt, H.R., Hill, J.O., et al., "Evaluation of the Atkins Diet: A Randomized Controlled Trial (RCT)," October 9, 2001, Abstract of the North American Association for the Study of Obesity Annual Meeting, Abstract #0132, Quebec City, Canada.

The Atkins Nutritional Approach™

- Four phases applied individually
- Based on the specific goal required to appropriately treat the individual

The Atkins Nutritional Approach™

- **Phase 1: Induction**

  Restrict carbohydrate consumption to 20 grams each day, obtaining carbohydrate primarily from salad and other non-starchy vegetables.

- **Phase 2: Ongoing Weight Loss (OWL)**

  Add carbohydrate, in the form of nutrient-dense and fiber-rich foods, by increasing to 25 grams daily the first week, 30 grams daily the next week and so on until weight loss stops. Then subtract 5 grams of carbohydrate from the daily intake so that continued sustained, moderate weight loss resumes.

The Atkins Nutritional Approach™

- **Phase 3: Pre-Maintenance**

  Make the transition from weight loss to weight maintenance by increasing the daily carbohydrate intake in 10-gram increments each week so long as very gradual weight loss is maintained until goal weight is reached.

- **Phase 4: Lifetime Maintenance**

  Select from a wide variety of foods while controlling carbohydrate intake to ensure weight maintenance and a sense of well-being. This lifestyle is the foundation for a lifetime of better health.

Example of Daily Menu With 20 Grams of Carbohydrate

Breakfast

Three Egg Omelet With Avocado,
Mozzarella Cheese and Tomato
Organic Nitrate-Free Bacon (2 Strips)
Decaffeinated Coffee With Cream

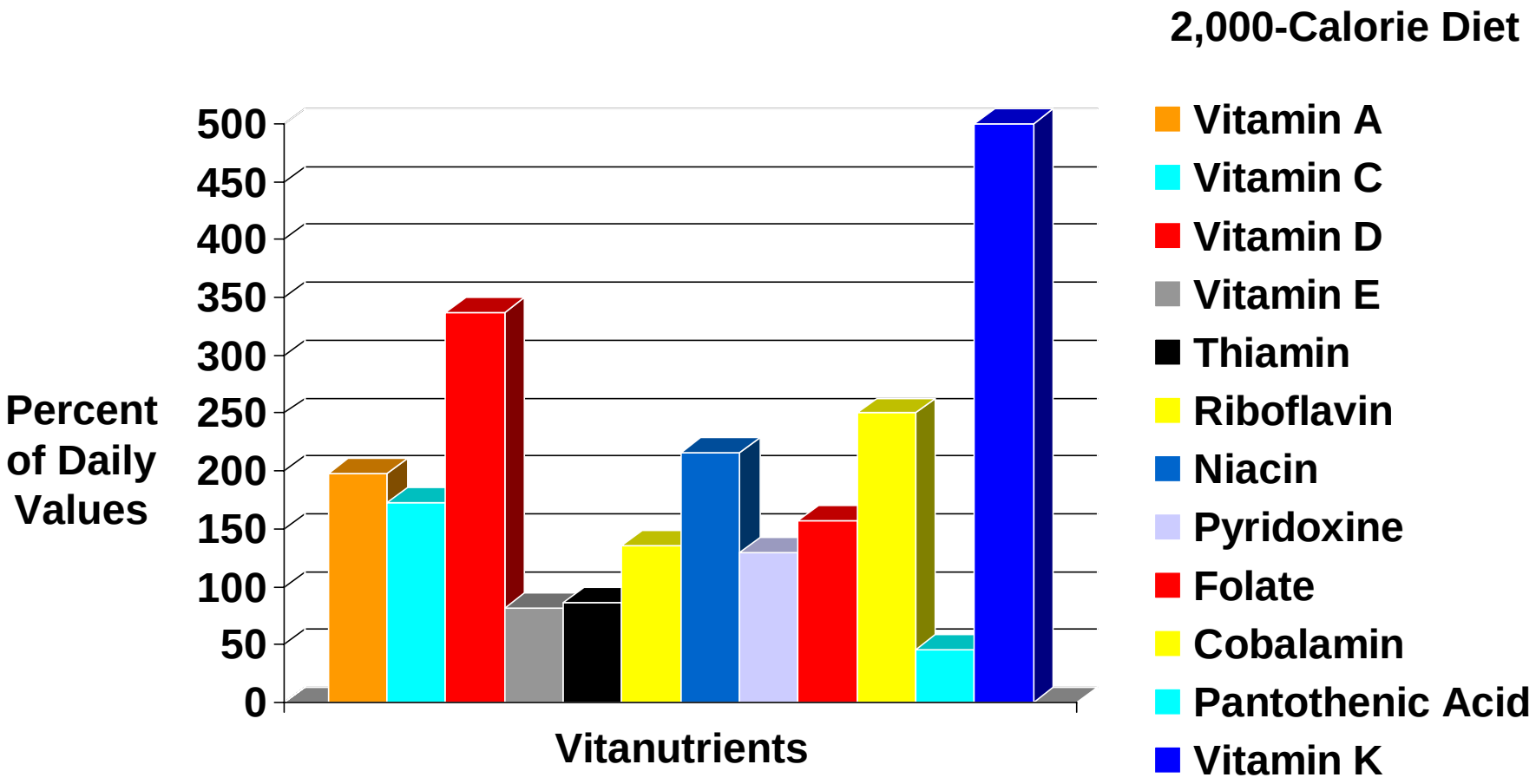
Lunch

Beef Round (8 oz)
Spinach and Mixed Leaf Salad With Mushrooms,
Onions, Celery and Parmesan Cheese
Club Soda

Dinner

Broiled Salmon (9 oz)
Kale Topped With Garlic, Lemon and Sesame Seeds
Spring Water

Nutrient Analysis of 20 Grams of Carbohydrate Sample Menu Based on Daily Values/RDI



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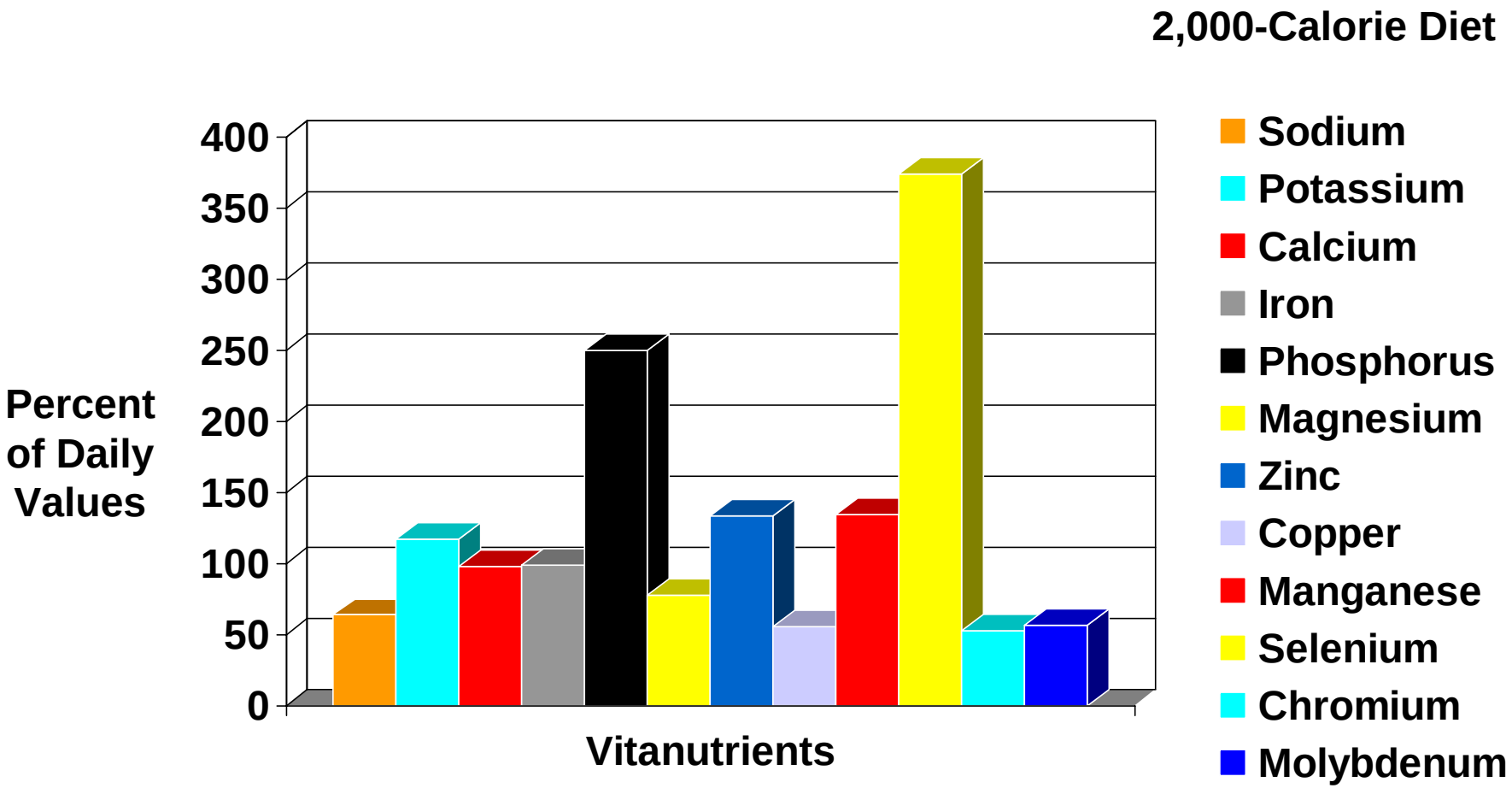

Conclusions

- A controlled carbohydrate lifestyle) is a viable treatment option for preventing and correcting the abnormalities seen in obesity and diabetes.
- For individuals with diabetes and obesity, long-term adherence to a controlled carbohydrate lifestyle is safe and effective for obtaining medical goals.
- When carbohydrates are sufficiently limited and very little insulin is produced, fat becomes the primary fuel.
- When a controlled carbohydrate regimen is followed correctly, misconceptions are unfounded and unsubstantiated.