

# The Nutrition of Obesity

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## Objectives

- Review the nutritional etiology of obesity.
- Establish the relevance of diet therapy for obesity.
- Explore the metabolic barriers to weight loss as well as the different types of dietary interventions.
- Identify other nutritional supplements which may aide you in treating obesity
- Identify other adjunct therapies for obesity

# How the Body Regulates Weight

- Regulation of body weight:
  - Complex homeostatic system
  - Hypothalamus is central coordinating area
  - Many homeostatic molecules involved in hunger and satiety:
    - Cholecystokinin
    - Insulin
    - Corticotropin-releasing hormone
    - Bombesin
    - Urocortin
    - Glucagon-like peptide-1
    - neuropeptide Y
    - peptide YY
    - MCH (melanocortin-concentrating hormone)
    - Galanin
    - Serotonin
    - Norepinephrine
    - Dopamine
    - Leptin
    - Ghrelin

Goldman: Cecil Textbook of Medicine, 21st ed., pg. 1157

# The Evidence Base for Nutrition and Obesity Prevention and Treatment

- Fundamental biology that links nutrition to the etiology of chronic diseases is incompletely understood.
- There are many strong relationships between factors such as body weight, physical activity levels, macronutrients, micronutrients, and the risk of these chronic diseases.
- It has been crudely estimated that modifiable nutritional factors, including physical activity, body weight, and food choices, might account for a substantial proportion of all deaths in the US.<sup>1</sup>
- The clearest evidence of the approximate magnitude of nutritional effects on chronic disease risk comes from the simplest of epidemiologic observations.

1. McGinnis J, Foege W. Actual causes of death in the United States. JAMA 1993;270:2207-12

## Cause of Death in America

Contributor	Estimated Number of Deaths
Tobacco	400,000
<b>Diet and Activity Patterns</b>	<b>300,000</b>
Alcohol	100,000
Microbial Agents	90,000
Toxic Agents	60,000
Firearms	35,000
Sexual Behavior	30,000
Motor Vehicles	25,000
Illicit Use of Drugs	20,000
Socioeconomic Status	Difficult to Determine
Access to Medical Care	Difficult to Determine

1. McGinnis J, Foege W. Actual causes of death in the United States. JAMA 1993;270:2207-12.

## Does Weight Loss Effect Mortality?

- Most epidemiologic studies indicate that weight loss or weight fluctuation increases mortality.<sup>1</sup>
- Intentional weight loss studies suggest that weight loss may increase survival among overweight and obese persons.<sup>2,3,4</sup>

1. Andres R, Muller DC, Sorokin JD. Long-term effects of change in body weight on all-cause mortality: a review. Ann Intern Med 1993; 119:737-743.

2. Williamson DF, Pamuk E, Thun M, et al. Prospective study of intentional weight loss and mortality in never-smoking overweight U.S. white women aged 40-64 years. Am J Epidemiol 1995; 141:1128-1141.

3. Williamson DF, Pamuk E, Thun M, et al. Prospective study of intentional weight loss and mortality in overweight white women aged 40-64 years. Am J Epidemiol 1999; 149:491-503.

4. Williamson DF, Thompson TJ, Thun M, et al. Intentional weight loss and mortality among overweight individuals with diabetes. Diabetes Care 2000; 23:1499-1500.

5. Gregg EW, Gerzoff MS, et al. Intentional weight loss and death in overweight and obese U.S. adults 35 years of age and older. Am J Med 2003 Mar;5:383-389.

## Biochemical Hurdles of Weight Loss

- Body tries to maintain fat stores by regulating the amount of food and calories consumed.
- Research with animals and humans has found that a person has a programmed “set point” weight.<sup>1</sup>
- The existence of this set point helps to explain why most diets do not work.
- In addition, their set point is now set at a higher level, making it even more difficult to lose weight.
- “Ratchet effect” and “yo-yo dieting”.
- The key to overcoming the fat cell’s set point appears to be increasing the sensitivity of the fat cells to insulin.

1. Kolata G. Why do people get fat? Science 1985; 227: 1327-1328  
2. Pizzorno; Textbook of Natural Medicine, 2nd ed., pg 1432-1433

## Dietary Interventions:

- Weight loss diets generally involve modifications of energy content and macronutrient composition.
- Dietary intervention is considered the cornerstone of weight loss therapy.
- Current recommendations center around decreasing caloric intake.

## Macronutrient Differences by Diet

Diet Program	Kcal from Carbohydrate (%)	Kcal from Protein (%)	Kcal from Fat (%)	Kcal from Saturated Fat (%)	Cholesterol (mg)	Fiber (gm)
Atkins	5	35	59	26	924	4
“Protein Power”	8	35	53	19	657	11
“Sugar Busters”	40	28	32	9	280	24
“The Zone”	32	28	32	7	264	18
Ornish	74	18	7	2	30	49
National dietary recommendations	55–58	12–15	30–35	<10	<300	20–30

Based on a 1600 cal diet

Data from Anderson JW, Konz EC, Jenkins DJA. Health advantages and disadvantages of weight-reducing diets: a computer analysis and critical review. J Am Coll Nutr 2000;19: 578–90.

## Low Calorie Diets

- *Balanced-deficit diets* of conventional foods usually contain more than 1500 kcal/day and an appropriate balance of macronutrients.
- *Low-calorie diets* (LCDs) contain 800 to 1500 kcal/day and are consumed as liquid formula, nutritional bars, conventional food, or a combination of these items.
- *Very-low-calorie diets* (VLCDs) contain less than 800 kcal/day and are generally high in protein (70 to 100 g/day) and low in fat (<15 g/day). Such diets may be consumed as a commercially prepared liquid formula and may include nutritional bars.

## Low Calorie Diet Treatment

- National Institutes of Health (NIH) Guidelines<sup>1</sup>:
  - **Overweight** (BMI of 25.0 to 29.9 kg/m<sup>2</sup>) and **two cardiovascular disease risk factors**
    - decrease their energy intake by approximately 500 kcal/day
  - **Class I obesity** (BMI of 30 to 34.9 kg/m<sup>2</sup>)
    - decrease their energy intake by approximately 500 kcal/day
  - **Class II or higher** (BMI of 35.0 kg/m<sup>2</sup> or higher)
    - energy deficit of 500 to 1000 kcal/day
- Composite results of trials indicate that an LCD providing 1000 to 1500 kcal/day induces about an 8% weight loss after 16 to 26 weeks of treatment.<sup>2</sup>

1. National Institutes of Health, National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. *Obes Res* 1998; 6(Suppl 2):31S-209S.

2. National Institutes of Health, National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. *Obes Res* 1998; 6(Suppl 2):31S-209S.

## Lower is Not Necessarily Better

- VLCDs induced a weight loss of about 15% to 20% in 12 to 16 weeks of treatment, but this weight loss was not usually maintained.<sup>1,2</sup>
- In fact, several randomized trials have shown that weight regain is greater after VLCD than LCD therapy.<sup>3,4,5,6,7</sup>

1. Wing RR, Marcus MD, Salata R, et al. Effects of a very-low-calorie diet on long-term glycemic control in obese type 2 diabetic subjects. *Arch Intern Med* 1991;151:1334-1340.

2. Torgerson JS, Lissner L, Lindross AK, et al. VLCD plus dietary and behavioral support versus support alone in the treatment of severe obesity: a randomized two-year clinical trial. *Int J Obes Relat Metab Disord* 1997; 21:987-994.

3. Wadden TA, Foster GD, Letizia KA. One-year behavioral treatment of obesity: comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *J Consult Clin Psychol* 1994; 62:165-171.

4. Wadden TA, Stunkard AJ. A controlled trial of very-low-calorie diet, behavior therapy, and their combination in the treatment of obesity. *J Consult Clin Psychol* 1986; 44:482-488.

5. Miura J, Arai K, Ohno M, Ikeda Y. The long term effectiveness of combined therapy by behavior modification and very low calorie diet: 2 year follow-up. *Int J Obes* 1989; 13:73-77.

6. Torgerson JS, Lissner L, Lindross AK, et al. VLCD plus dietary and behavioral support versus support alone in the treatment of severe obesity: a randomized two-year clinical trial. *Int J Obes Relat Metab Disord* 1997; 21:987-994.

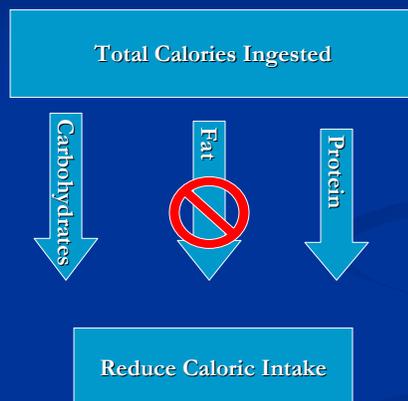
7. Rytting KB, Flaten H, Rossner S. Long-term effects of a very low calorie diet (Nuzilett) in obesity treatment: a prospective, randomized comparison between VLCD and a hypocaloric diet + behavior modification and their combination. *Int J Obes Relat Metab Disord* 1997; 21:574-579.

## Dangers of Severe Caloric Restriction

- Side effects of these severe calorie restricted diets include:
  - Orthostatic hypotension
  - Fatigue
  - Cold intolerance
  - Dry skin
  - Hair loss
  - Menstrual irregularities
  - Cholelithiasis
  - Cholecystitis
  - Pancreatitis (rare)

Goldman: Cecil Textbook of Medicine, 21st ed., pg. 1161

## Premise of Low Fat Diet



## Low Fat Diets

- Facilitate energy restriction.
- Epidemiologic and diet intervention studies suggest that increased dietary fat intake is associated with increases in total energy intake and body weight.<sup>1</sup>
- Triglycerides increase the palatability and energy density of food.
- A direct relationship between changes in dietary fat intake and body weight was found in Meta-analysis of 37 intervention studies involving the Step I or Step II low-fat (<30% kcal as fat) diet recommended by the National Cholesterol Education Program to lower cardiovascular risk.<sup>2</sup>
- Amount of weight loss induced by a low-fat diet may be directly related to the severity of obesity.<sup>3</sup>

1. Bray GA, Popkin BM. Dietary fat intake does affect obesity! Am J Clin Nutr 1998; 68:1157–1173.

2. Yu-Poth S, Zhao G, Etherton T, et al. Effects of the National Cholesterol Education Program's Step I and Step II dietary intervention programs on cardiovascular disease risk factors: a meta-analysis. Am J Clin Nutr 1999; 69:632–646.

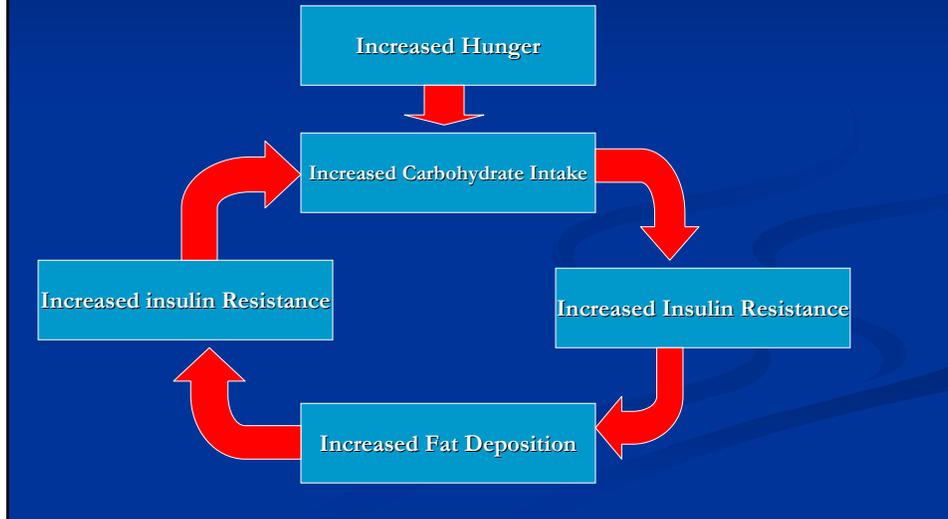
3. Astrup A, Grunwald GK, Melanson EL, et al. The role of low-fat diets in body weight control: a meta-analysis of ad libitum dietary intervention studies. Int J Obes Relat Metab Disord 2000; 24:1545–1552.

## The “Super Size” it Generation

- Energy intake may be regulated by portion size rather than energy content.<sup>1</sup>
- Despite an apparent decrease in fat intake over the past decade, the weight of Americans continues to rise.

1. Rolls BJ, Bell EA. Dietary approaches to the treatment of obesity. Med Clin North Am 2000; 84:401–418.

## Carbohydrate Vicious Cycle Hypothesis



## Low Carbohydrate:

- Several short term studies suggest that, despite equal energy intakes, initial weight loss during the first 4 weeks may be greater with a low-carbohydrate than with a high-carbohydrate diets.<sup>1</sup>
- Possible explanations for promotion of weight loss by low-carbohydrate diets, despite unlimited fat and protein intakes, include:
  - Initial diuresis associated with ketone and urea nitrogen excretion<sup>1</sup>
  - Losses of up to 100 kcal/day in urinary ketones<sup>2</sup>
  - Decreased energy intake, which may be related to ketosis, diet monotony, or other unknown mechanisms.
  - Decreased insulin resistance
- Hypothesized deleterious effects:<sup>2</sup>
  - Dehydration
  - Electrolyte imbalance
  - Hyperuricemia
  - Calciuria
  - Kidney stones
  - Glycogen depletion with easy fatigue
  - Hyperlipidemia
- No serious adverse effects were reported<sup>3</sup>
- In fact, these diet changes have shown 43% decrease in plasma triglycerides, an 18% increase in plasma HDL-cholesterol, and a 7% decrease in plasma LDL-cholesterol.

1. Yang M-U, Van Itallie TB. Composition of weight lost during short-term weight reduction. *J Clin Invest* 1976; 58:722-730.
2. Council on Foods and Nutrition. A critique of low-carbohydrate ketogenic weight reduction regimens. *JAMA* 1973; 224:1415-1419.
3. Westman EC, Yancy WS, Edman JS, et al. Effects of a very-low-carbohydrate diet program on body weight: a pilot study (abstract). *Obes Res* 2000; 8(Suppl 1):738.

## Recent Comparison Data of Low Carbohydrate Diet to Low Fat

- Recent studies show that the low carbohydrate diets may be superior to low fat diets.<sup>1,2</sup>

1. J Clin Endocrinol Metab 2003;88:1617-1623

2. Westman EC, Yancy WS, Edman JS, Tomlin KF, Perkins CE. Effect of 6-month adherence to a very low carbohydrate diet program. AM J Med. 2002 Jul;113:30-36

## What About the Role of Serotonin?

- When animals and humans are fed diets deficient in tryptophan, appetite is significantly increased, resulting in binge eating of carbohydrates.<sup>1,2</sup>
- Theory that low serotonin levels leads to “carbohydrate craving” and plays a major role in the development of **obesity**.
- It has been demonstrated that concentrations of tryptophan in the bloodstream and subsequent brain serotonin levels plummet with dieting.<sup>3</sup>

1. Wurtman RJ, Wurtman JJ. Brain serotonin, carbohydrate-craving, **obesity** and depression. Adv Exp Med Biol 1996; 398: 35-41

2. Wurtman J, Suffes S. The Serotonin Solution. New York: Fawcett Columbine, 1997

3. Goodwin GM, Cowen PJ, Fairburn CG et al. Plasma concentrations of tryptophan and dieting. Br Med J 1990; 300: 1499-1500

## Fiber supplements

- Increasing the amount of dietary fiber promotes weight loss.
- The best fiber sources for weight loss are psyllium, chitin, guar gum, glucomannan, gum karaya, and pectin.
- Other benefits of fiber:<sup>1</sup>
  - Enhance blood sugar control
  - Decrease insulin levels
  - Reduce the number of calories absorbed by the body

1. Spiller GA. Dietary fiber in health and nutrition. Boca Raton, FL: CRC Press. 1994

## Chromium

- Chromium plays a key role in cellular sensitivity to insulin.
- There is no recommended dietary allowance (RDA) for chromium, health requires a dietary intake of at least 200 mcg/day<sup>1</sup>
- Chromium levels can be depleted by refined sugars, white flour products, and lack of exercise.<sup>2</sup>
- In diabetics, supplementing the diet with chromium has been shown to:<sup>2</sup>
  - Decrease fasting glucose levels
  - Improve glucose tolerance
  - Lower insulin levels
  - Decrease total cholesterol and triglyceride levels
  - Increasing HDL-cholesterol levels.
  - Ameliorate the symptoms of hypoglycemia
- Chromium supplementation has been demonstrated to lower body weight yet increase lean body mass, presumably as a result of increased insulin sensitivity.<sup>3</sup>
- The 400 mcg dose is more effective than the 200 mcg dose

1. Pizzorno: Textbook of Natural Medicine, 2nd ed., pg 1436

2. Martz W. Chromium in human nutrition: a review. J Nutr 1993; 123: 626-633

3. McCarthy MF. Hypothesis: sensitization of insulin-dependent hypothalamic glucoreceptors may account for the fat-reducing effects of chromium picolinate. J Optimal Nutr 1993; 21: 36-53

## Chromium

- There is evidence that marginal chromium deficiency is quite common in the United States.
- There are several forms of chromium available:
  - Chromium picolinate
  - Chromium polynicotinate
  - Chromium chloride
  - Chromium-enriched yeast

## Medium-chain triglycerides

- Medium-chain triglycerides (MCTs) are saturated fats (extracted from coconut oil) that range in length from 6 to 12 carbon chains.
- Unlike regular fats, MCTs appear to promote weight loss rather than weight gain.
- MCTs may promote weight loss by increasing thermogenesis.<sup>1</sup>
- In order to gain the benefit from MCTs, a diet must remain low in LCTs.
- MCTs can be used as an oil for salad dressing, a bread spread, or simply taken as a supplement.
- A good dosage recommendation for MCTs is 1–2 tablespoons/day.

1. Baba N, Bracco EF, Hashim SA. Enhanced thermogenesis and diminished deposition of fat in response to overfeeding with diet containing medium chain triglyceride. Am J Clin Nutr. 1982; 35: 678–682

## Coenzyme Q10

- Coenzyme Q10 is an essential compound required in the transport and breakdown of fatty acids into energy.
- Clinical studies have shown that CoQ10 may help to promote weight loss.

Pizzorno: Textbook of Natural Medicine, 2nd ed., pg

## Multivitamins

- Generally recommended in weight loss.
- Data establishing effect on weight loss is lacking.

## Behavior Therapy

- Second, eating and physical activity patterns are learned behaviors and can be modified.
- Behavior Modification Techniques
  - Self Monitoring
  - Stimulus Control
  - Behavioral Contracting
  - Cognitive Restructuring
  - Stress Management
  - Relapse Prevention
  - Social Support

Hyder et al Behavior Modification in the treatment of Obesity: Practical Approaches for Family Physicians Clinics in Family Practice June 2002;2

## Benefits of Physical Activity for Health and Weight Control

- Improves cardiovascular health, independent of weight loss
- Improves mood and energy level
- Increase weight loss compared with diet alone
- Spares loss of fat-free mass during weight loss
- Predicts weight loss maintenance

## Summary

- Obesity is a complex disorder that is multifactorial in etiology which is difficult to study by conventional studies.
- Diet therapy is the cornerstone of treatment for obesity.
- The current under riding principal of treatment is calorie restriction.
- Diets will vary in their macronutrient composition.
- Consider adjunct use of chromium, co-enzyme Q10, multivitamin, behavioral modification and exercise.