Diet and Weight Control

The Fattening of America: World Wide Epidemic


130 million Americans
65% of the population
(35% college students)

Eating More of Just About Everything: 30 Year Comparison

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Prepared for: Jane Smith

Date: 11/26/2011
Circa 1950’s

Circa 2008

$20.00   4,800
Calorie Burger

• 8-inch sesame seed bun (requires 1 lb of dough
• 1 cup of chili
• Five 1/3 pound hamburger patties
• 5 slices of American cheese
• Liberal doses of salsa, nacho cheese, and fritos
• Topped off with lettuce, tomato and sour cream

MUST BE SLICED WITH A PIZZA CUTTER!

Health Risks Associated with Excessive Body Fat
Relative Risk for Hypertension According to Weight Change After Age 18

N=82,000 Female Nurses 30-55yr

Horizontal Red Indicates Normal Risk


Body Fatness for Health and Fitness

- Recommended body fatness
  - Males
    - 10–20%
  - Females
    - 15–25%
- Health concerns above and below these values
  - Obesity
  - Anorexia nervosa and bulimia nervosa
- Calculation of optimal weight

Optimal weight = Fat-free weight
(1 – optimal % fat)

Determining Your Desirable Body Weight

- Desirable Weight = Lean body mass/[1 - %fat desired/100]
  - Fat Weight = Current weight x (% fat/100)
  - Lean Body Mass = Current weight – Fat weight

Example: Mr. Jones weighs 200 lbs and has 22% body fat. His recommended healthy % fat for his age is 15%.

What is his desirable bodyweight?

- Fat weight = 200 lbs x (0.22) = 44 lbs
- LBM = 200 lbs – 44 lbs = 156 lbs
- Desirable Body Weight = 156 / (1-15%/100)

183.5 or 184 lbs
• Research with twins, adopted children, and specific segments of the population attribute up to 80% of the risk of becoming obese to genetic factors
• If a child under age 10, regardless of current weight, has one or both obese parents, the child has more than twice the normal risk of becoming an obese adult
• Genetic makeup does not necessarily cause obesity, but instead lowers the threshold for its occurrence—sedentary and stressful, with ready access to inexpensive, large-portion, high-calorie, good-tasting food—the genetically susceptible individual gains weight

Genetics and Fat Accumulation

Obesity Genes
• Researchers now link human obesity to a mutant gene
  – Congenital absence of leptin, a hormonal body weight-regulating substance produced by fat and released into the bloodstream that acts on the hypothalamus, produced continual hunger and marked obesity in studies
  – Neither short- nor long-term exercise meaningfully affects leptin levels
• The linkage of genetic and molecular abnormalities to obesity allows researchers to view overweightness as a disease rather than a psychologic flaw

Fat Cell Size vs. Number and Obesity
• 25 billion fat cells in normal-weight individual
  – 60–80 billion in obese individual
• During weight loss
  – Fat cell size decreases, not fat cell number
• Severe obesity (fat mass >30 kg)
  – Due to increase in fat cell number (hyperplasia)
  – Due to increase in fat cell size (hypertrophy)
  – Associated with greater difficulty losing weight and maintaining weight loss
Relationship Between Fat Cell Size and Fat Cell Number to Total Body Fat

Criteria for Excessive Body Fat: Fat Cell Size and Number

An average person has about 25 to 30 billion fat cells, the moderately obese has between 60 and 100 billion, and the massively obese has 360 billion or more.

As body fat increases, adipocytes eventually reach a biologic upper limit once this occurs, cell number becomes the key factor determining any further obesity.

Increases in adipose tissue mass occur in two ways:
- Fat cell hypertrophy: Existing adipocyte enlarge or fill with fat.
- Fat cell hyperplasia: Total adipocyte number increases.

Set Point and Obesity

- Set point theory
  - Biological set point for body weight much like the set points for other physiological variables.
- Physiological set point model
  - Biological signals provide input to hypothalamus
    - Blood glucose, lipid stores, weight on feet
    - Food intake is either increased or decreased to maintain body weight
- Cognitive set point model
  - Cognitive signals about perception of body weight
  - Influences food intake to maintain body weight
Setpoint Theory: A Case Against Dieting

- States that all persons (fat or thin) have a well-regulated internal control mechanism located deep within the lateral hypothalamus that maintains with relative ease a preset level of body weight and/or body fat within a tight range
- Exercise and FDA-approved antiobesity drugs may lower a person’s setpoint, whereas dieting exerts no effect
- Each time body weight decreases below one’s pre-established setpoint, internal adjustments that affect food intake and regulatory thermogenesis resist the change and conserve and/or replenish body fat
Effects of Weight Gain

- The total number of fat cells probably cannot be altered to any significant degree during adulthood.
- Gain
  - In general, moderate weight gain from overeating in adults enlarges existing adipocytes rather than stimulating new adipocyte development.

Changes in adipose cellularity with weight reduction in obese subjects

Loss
In adults, the major change in adipose cellularity in weight loss is shrinkage of adipocytes with no change in cell number.

The Energy Balance Equation

- The energy balance equation dictates that body mass remains constant when caloric intake equals caloric expenditure.
- Ways to unbalance the equation to produce weight loss:
  - Reduce caloric intake below daily energy requirements
  - Maintain caloric intake and increase energy expenditure through additional physical activity above daily energy requirements
  - Decrease daily caloric intake and increase daily energy expenditure
Dieting for Weight Control

• The first law of thermodynamics affirms that weight loss occurs whenever energy output exceeds energy intake, regardless of the diet’s macronutrient mixture
• A prudent dietary approach to weight loss reduces energy intake by 500 to 1000 kCal
• Moderately reduced food intake produces greater fat loss relative to the energy deficit than more severe energy restriction

Diet Plans

Ketogenic Diets

• Emphasize carbohydrate restriction while generally ignoring total calories and the diet’s cholesterol and saturated fat content
• Must restrict daily carbohydrate intake to 20 g or less for the initial 2 weeks, with some liberalization afterward

Low Carbohydrate-Ketogenic Diets

• The diet poses nine potential health hazards:
  — 1. Raises serum uric acid levels
  — 2. Potentiates development of kidney stones
  — 3. Alters electrolyte concentrations to initiate cardiac arrhythmias
  — 4. Causes acidosis
  — 5. Aggravates existing kidney problems from the extra solute burden in the renal filtrate
  — 6. Depletes glycogen reserves, contributing to a fatigued state
  — 7. Decreases calcium balance and increases risk for bone loss
  — 8. Causes dehydration
  — 9. Retards fetal development during pregnancy from inadequate carbohydrate intake
High-Protein Diets

• May shed pounds short term, but their long-term success remains questionable and may even pose health risks.
• Protein-rich foods often contain high levels of saturated fat, increasing risk for heart disease and type 2 diabetes.
• A high-protein diet has the potential to cause:
  — Strain on liver and kidney function and accompanying dehydration
  — Electrolyte imbalance
  — Glycogen depletion
  — Lean-tissue loss

Semi-Starvation Diets

• Very low-calorie diet (VLCD) may benefit severe clinical obesity where body fat exceeds 40 to 50% of body mass.
• Provides between 400 and 800 kCal daily as high-quality protein foods or liquid meal replacements
• Dieting with VLCD requires close supervision, usually in a hospital setting
• For most individuals, semi-starvation does not compose an “ultimate diet” or proper approach to weight control.

Weight Loss

Drugs, Dietary Supplements,

• Little evidence that dietary supplements work
• Drugs, if they work, may have side effects
  — Fen-phen promoted weight loss but caused:
    • Pulmonary hypertension
    • Heart valve abnormalities
    • Electrocardiographic abnormalities
• Key points
  — Focus of weight loss programs should be long-term diet and exercise behaviors
  — Most drugs are for short-term use only
  — If all the diet books, pills, and supplements worked, obesity would not be a problem
Percent Composition of Weight Loss: 4 Wks Caloric Restriction

Hydration level:
~70% of the weight lost over the first week of energy deficit consists of water loss.

Water loss progressively lessens while body fat loss increases from 25 to 70%.

Restricting water during the first days of a caloric deficit causes more total weight loss to occur, but the additional weight lost comes solely from water as dehydration progresses.

Principles of Weight Control: Diet and Exercise

• If total food calories exceed daily energy expenditure, excess calories accumulate and store as fat.
• The energy balance equation says body mass remains constant when caloric intake equals caloric expenditure.
• To unbalance the equation to produce weight loss:
  – Reduce caloric intake below daily energy requirements.
  – Maintain caloric intake and increase energy expenditure.
  – Decrease daily caloric intake and increase daily energy expenditure.

Exercise for Weight Control

• Excess weight gain often parallels reduced physical activity rather than increased caloric intake.
• An increased level of regular physical activity combined with dietary restraint maintains weight loss more effectively than long-term caloric restriction alone.
• A negative energy balance induced by increased caloric expenditure unbalances the energy balance equation for weight loss, improves physical fitness and the health risk profile, and favorably alters body composition and body fat distribution for children and adults.
Effectiveness of Regular Exercise

• Adding physical activity to a weight-loss program favorably modifies the composition of the weight lost in the direction of greater fat loss.
• Total energy expended in physical activity relates in a dose–response manner to the effectiveness of exercise for weight loss.
• A reasonable goal progressively increases moderate exercise to between 60 and 90 minutes daily or a level that burns 2100 to 2800 kCal weekly.

Spot Reduction

• States that an increase in a muscle’s metabolic activity stimulates relatively greater fat mobilization from the adipose tissue in proximity to the active muscle
  – For example, performing large numbers of sit-ups or side-bends will reduce excessive abdominal and hip fat
• Critical evaluation of the research evidence does not support its use.
• The negative energy balance created through regular exercise contributes to reducing total body fat.
• Exercise stimulates mobilization of fatty acids via hormones and enzymes that act on fat depots throughout the body not simply from areas closest to the active muscle mass.

Resistance Training

• Resistance training positively affects muscular strength and FFM during weight loss compared with programs that rely solely on food restriction
• Individuals who maintain high muscular strength levels tend to gain less weight than weaker counterparts
• Standard resistance training performed regularly reduces coronary heart disease risk, improves glycemic control, favorably modifies the lipoprotein profile, and increases resting metabolic rate
The potential for successful long-term weight loss maintenance generally varies inversely with the initial degree of fatness. For most individuals, initial success in weight loss relates poorly to long-term success. Participants in supervised weight-loss programs lose about 8-12% of their original body mass. However, typically one to two-thirds of the lost weight returns within a year, and almost all of it within 5 years.

**Long-Term Success**

<table>
<thead>
<tr>
<th>Degree of obesity</th>
<th>Potential for success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>High</td>
</tr>
<tr>
<td>Overweight</td>
<td>Moderate</td>
</tr>
<tr>
<td>Severe</td>
<td>Low</td>
</tr>
<tr>
<td>Morbid</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Percentage of patients remaining at reduced weights following weight loss

Physical Activity for Weight Control

- To reduce the risk of chronic disease
  - 30 minutes of moderate-intensity physical activity on most days of the week
- To manage weight and prevent gradual weight gain
  - 60 minutes of moderate- to vigorous-intensity activity on most days of the week
- To sustain weight loss
  - 60–90 minutes of moderate-intensity physical activity
Caloric Restraint Plus Exercise: The Ideal Combination

- Combinations of increased physical activity and caloric restraint offer considerably more flexibility for achieving a negative caloric imbalance than either exercise or diet alone
- Dietary restraint plus increased physical activity through lifestyle changes offers health and weight-loss benefits similar to those from combining dietary restraint and a vigorous program of structured exercise
- Adding exercise to a weight-control program facilitates longer-term maintenance of fat loss than total reliance on either food restriction or increased exercise alone

Energy Expenditure and Weight Control

- Basal metabolic rate (BMR)
  - Rate of energy expenditure under standardized conditions
    - Supine position, immediately after rising, 12–18 hours following a meal
    - Similar to resting metabolic rate (RMR)
  - Represents 60–75% total energy expenditure
    - Lower in women, declines with age
    - Related to fat-free mass
  - Reduced in response to reduced caloric intake (dieting or fasting)
    - Exercise can maintain BMR

A Calorie Is a Calorie

- In most studies, diet results in more weight loss than exercise
  - Is a calorie of exercise equal to a calorie of diet restriction?
- Study by Ross, et al.
  - Deficit of 700 kcal/day
    - Through exercise or diet
    - Both treatments lost 16.5 lbs—exactly what was predicted
    - Exercise group lost more fat and preserved muscle
- Similar results in another study
  - Equal caloric deficit through diet alone vs. diet plus exercise
Effect of Exercise on Appetite

- Most humans
  - Energy intake is increased across a broad range of energy expenditure
  - Maintains body weight
- Formerly sedentary individuals
  - Net loss of appetite on an exercise program
  - Facilitates weight loss

How Much Physical Activity is Enough?

- American College of Sports Medicine recommends:
  - Adults participate in at least 150 min wk\(^{-1}\) of moderate-intensity physical activity
  - Overweight and obese individuals should participate in physical activity that approximate 250 to 300 min wk\(^{-1}\)

Pattern of Caloric Intake Versus Occupational Activity
Exercise and Body Composition

• Individuals who exercise generally have lower body weight and percent fat
• Weight loss in conjunction with exercise
  – Less lean body mass is lost
  – More fat mass is lost
• In general, those doing the largest amount of physical activity had the largest changes in percent body fat

Successful Losers—How Much Exercise Is Needed to Keep the Weight Off?

• To maintain weight and prevent weight gain
  – 60 min per day of moderate-intensity exercise
• To sustain weight loss:
  – 60–90 min/day of moderate-intensity exercise
• National Weight Control Registry “Successful losers”
  – Average weight loss of 30 kg for 5.5 years
  – No evidence of psychological distress
  – Limited caloric intake to 1,400 kcal/day with 25% calories from fat
  – Expended 400 kcal/day through physical activity

Successful Losers—How Much Exercise is Needed to Keep the Weight Off?

• Strategies for long-term weight loss (NWCR)
  – Engaging in high-level physical activity
  – Eating a diet low in calories and fat
  – Consistent eating plan, including breakfast
  – Self-monitoring weight regularly
  – Catching slips before they result in weight regain
Caloric Cost for Walking, Jogging, and Running

| TABLE 18.7: Net Caloric Cost Per Mile for Walking, Jogging, and Running |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Walking                         |                 |                 |                 |                 |                 |
| Male                            |                |                 |                 |                 |                 |
| Height (cm)                     | 154            | 167             | 180             | 194             | 207             |
| Net cost (cal/kg · mile⁻¹)      | .77            | .77             | .77             | .76             | .75             |
| Female                          |                |                 |                 |                 |                 |
| Height (cm)                     | 153            | 153             | 153             | 153             | 153             |
| Net cost (cal/kg · mile⁻¹)      | .73            | .73             | .73             | .73             | .73             |

Jogging/Running

<table>
<thead>
<tr>
<th>TABLE 18.8: Estimated Net Energy Expenditure at 75% of VO2 Max Running</th>
<th>Mean of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2 Max (mL/kg · min)</td>
<td>110</td>
</tr>
<tr>
<td>Net energy expenditure (cal/kg · min)</td>
<td>690</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>53</td>
</tr>
<tr>
<td>Activity level (MET)</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Note: body weight is used for the calculation of the number of calories used per mile.

Fat Loss on the Body

- Decreases in body fat reduce upper-body subcutaneous and deep abdominal fat rather than the more “resistant” fat depots in gluteal and femoral regions.
- Men generally respond more favorably than women to effects of exercise on weight loss, which may be due to:
  - Gender difference in body fat distribution
  - Women may more effectively preserve energy balance with increased physical activity
  - Men often reduce energy intake with exercise training, whereas the depression of food intake with exercise may be less for women.
Increase the Lean, Not the Fat

- Endurance exercise training usually increases FFM only slightly while muscular overload through resistance training increases muscle mass and strength.
- Therefore, intense aerobic training should not coincide with resistance training to increase muscle mass.
- A 1-year program of heavy resistance training for young, athletic men increases body mass by about 20%.
  - The rate of lean tissue gain rapidly plateaus as training progresses beyond the first year.
- For athletic women, first-year gains in lean tissue mass average 50-75% of the absolute values for men.