Energy Balance, Exercise & Weight Control

HNF 610: Nutrition & Fitness
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Chapter 14

Energy Balance, Exercise, and Weight Control
Obesity in the United States

- Increasing in all regions
- In 2005, only 4 states had obesity prevalence rates less than 20%.
- 17 states had prevalence rates equal to or exceeding 25%.
- Obesity rates in Louisiana, Mississippi, and West Virginia exceeded 30%.
- Overweight occurrence particularly affects women (Hispanic, African American, Pacific Islanders) and minority groups.

1990

1998

2006

No Data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | ≥30%

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Worldwide Epidemic

- Increases in obesity worldwide have contributed to the rising tide of type 2 diabetes and cardiovascular disease.
- Overweight but not obese, nonsmoking men and women in their mid-30s to mid-40s die at least 3 years sooner than normal-weight counterparts.
- Obese individuals can expect an approximately 7-year decrease in longevity.
Survival Estimates by BMI
Overweight Prevalence

- Between 1988 and 1991, one-third of adults aged 20 to 74 years classified as overweight.
- Obesity incidence is particularly high among Hispanic, African American, and Pacific Islander females and other minority groups.
- Based on the most recent estimates, more than 50% of non-Hispanic black women aged 40 years and older are obese, and more than 80% are overweight.
The Fattening of America
U.S. Preventive Services Task Force

- Government advisory group
- Urged physicians to:
  - Weigh and measure all patients
  - Recommend counseling and behavior therapy for individuals found to be obese
  - Prescribe intensive behavior therapy at least twice a month for up to 3 months
Prevalence Among Children

- The incidence of overweight among American youth has more than doubled in the last 15 years.
- The rapid rate of increase remains particularly prevalent among poor and minority children in whom excessive body fat represents the most common chronic disorder.
- In Australia, in the period from 1985 to 1997, the prevalence of overweight and obesity combined doubled and that of obesity tripled, far greater increases than the previous 16 years.
BMI Ages 2-20 years old
Overweight, Overfat, and Obesity

- The overweight condition simply refers to a body weight that exceeds some average for stature and perhaps age.
- Overfatness refers to a condition where body fat exceeds an age- and/or gender-appropriate average.
- Obesity refers to the overfat condition that accompanies a constellation of comorbidities.
Health Risks of Obesity

- Second leading cause of preventable death in America
- The estimated number of annual deaths attributed to obesity ranges between 280,000 and 325,000.
- Comorbidities include:
  - Hypertension, elevated blood sugar, pulmonary dysfunction including asthma and sleep apnea, psychiatric problems, postmenopausal breast cancer, pancreatic cancer, gastrointestinal disorders including gallstones, elevated total cholesterol and low HDL cholesterol levels, type 2 diabetes, and cardiovascular disease, with a somewhat stronger impact on diabetes risk
Physical Activity

- Exerts a considerable influence in reducing risk for cardiovascular disease and a more moderate effect on diabetes risk.
- Maintaining an increased level of physical activity attenuates the age-related increases in body weight and body fat.
- Increased regular physical activity, not dieting and/or short-term exercise, should become the important consideration in exercise prescription for weight control and good health.
Genetics

- Body weight should be viewed as the end result of complex interactions between one’s genes and environmental influences.
- Research with twins, adopted children, and specific segments of the population attribute up to 80% of the risk of becoming obese to genetic factors.
- Racial factors contribute
Genetic vs. Transmissible

Percent Body Fat and Fat Mass

Cultural transmission (30%)

Genetic (25%)

Nontransmissible
Genetic Model of Obesity

Step 1. The gene inside of the fat cells creates a hormone responsible for satiety.

Step 2. The satiety hormone moves from the fat cells and enters the bloodstream.

Step 3. The satiety hormone signals the hypothalamus to reduce or stop the drive to eat after the "set point" is reached for the body's total quantity of fat.
Mechanisms for Weight Gain

- The mutation of a gene called obese (or simply ob) disrupts hormonal signals that regulate metabolism, fat storage, and appetite.
- Depressed leptin receptor sensitivity signals the brain that the body lacks fat reserves, often triggering overeating.
- The UCP2 gene activates a protein that stimulates the burning of excess calories as heat without coupling to other energy-consuming process.
Biochemicals That Influence Eating Behaviors

- Leptin
- Peptide YY3-36 (PYY)
- Neuropeptide Y
- Ghrelin
- Melanocortin-4
Weight Loss in Athletes

- Achieving a lighter body weight and favorable body composition offers overall health benefits for athletes.
- In weight-bearing competitive sports like racewalking, running, cross-country skiing, and ice skating, energy cost relates directly to body mass.
- Combining moderate food restriction with additional daily physical activity offers the greatest flexibility for achieving fat loss, yet remaining well nourished for training and peak performance.
The Energy Balance Equation
Applied to Weight Loss

- If total daily food calories exceed daily energy expenditure, excess calories accumulate as fat in adipose tissue.
- Conversely, if energy expenditure exceeds the energy from food intake, body weight decreases.
- Three methods unbalance the energy balance equation to produce weight loss:
  - Reduce caloric intake below daily energy requirements
  - Maintain daily caloric intake and increase energy expenditure through additional physical activity
  - Decrease daily caloric intake and increase daily energy expenditure
Dieting to Tip the Energy Balance Equation

- Weight loss occurs whenever energy output exceeds energy intake regardless of the diet’s macronutrient mixture.
- A prudent dietary approach to weight loss unbalances the energy balance equation by reducing daily energy intake 500 to 1000 kCal below daily energy expenditure.
- Total energy intake, not diet composition, determines the effectiveness of weight loss with reduced-energy diets.
Set-Point Theory

- The proponents of a set-point theory maintain that all persons (fat or thin) have a well-regulated internal control mechanism located deep within the lateral hypothalamus that tightly maintains a preset level of body weight and/or body fat.
- Each time body fat decreases below one’s pre-established set point, internal adjustments and regulatory mechanisms resist the change and attempt to conserve and/or replenish body fat.
Effect of caloric intake on body mass and resting oxygen uptake
Extremes of Dieting

- Low-Carbohydrate Ketogenic Diets
  - Atkins
- The South Beach Diet
- High-Protein Diets
- Semistarvation Diets
  - Very Low Calorie Diets (VLCD)
The Appropriate Diet Plan

- A calorie-counting approach to weight loss should provide an appropriate dietary plan that contains all the essential nutrients.
- Two factors largely determine one’s daily energy expenditure:
  - Resting energy requirement
  - Energy expended in daily physical activities
Components of Total Daily Energy Expenditure

1. Resting metabolic rate (~60-75%)
   - Sleeping metabolism
   - Basal metabolism
   - Arousal metabolism

2. Thermic effect of physical activity (~15-30%)
   - In occupation
   - In home
   - In sport and recreation

3. Thermic effect of feeding (~10%)
   - Obligatory thermogenesis
   - Facultative thermogenesis
Maximizing Chances for Success with Dieting

- Human eating behavior is intimately tied to both external (environmental) cues and internal (physiologic) cues that signal a real need for food intake.
- Accurately assessing food intake and energy expenditure provides the framework for unbalancing the energy balance equation to favorably modify body mass and body composition.
- A dieter must learn to make accurate appraisals of eating behavior, not only the quantity and frequency of eating but also specific circumstances linked to food intake.
Behavioral Approaches Can Help

- The person keeps meticulous records and answers the following eight questions:
  - When were meals eaten?
  - In what place were meals eaten?
  - What was the mood, feeling, or psychological state during the meal?
  - How much time was spent eating?
  - What activities were engaged in during the meal?
  - Who was present during the meal?
  - What food was eaten?
  - How much food was eaten?
Developing New Techniques to Control Eating

- **Delaying**
  - Add time or steps between the links in the behavior chain.

- **Substituting**
  - Break the behavior chain with activities incompatible with eating.

- **Avoiding**
  - Keep yourself out of situations in which food is visible or easily accessible.
Exercise for Weight Control

- Regular physical activity plays a central role in protecting against weight gain.
- Men and women of all ages who maintain a physically active lifestyle maintain a more desirable level of body composition than less active counterparts.
- Even for currently active individuals, additional exercise unbalances the energy balance equation for weight loss.
Behavior Modification

Four techniques can help to maximize success when using exercise for weight loss:

• Progress slowly
• Include variety
• Become goal oriented
• Be systematic
Spot Reduction

- The notion of spot reduction comes from the belief that increasing a muscle’s activity facilitates fat mobilization from the adipose tissue in close proximity to the muscle.
- Exercising a specific body area does not selectively reduce more fat from that area than if different muscle groups are exercised at the same caloric intensity.
Gender Difference in Exercise Effects on Weight Loss

- Fat distributed in the upper body and abdominal regions (central fat) shows an active lipolysis to sympathetic nervous system stimulation and preferentially mobilizes for energy during exercise.

- The greater distribution of upper body adipose tissue in men than in women may contribute to their greater sensitivity to lose fat with regular exercise.
Effects of Diet and Exercise on Body Composition During Weight Loss

- Addition of exercise to a weight loss program favorably modifies the composition of the weight lost in the direction of greater fat loss.
- For body fat reduction, combining diet and exercise proves most effective.
Changes in body composition with resistance exercise and diet in obese females
Weight Loss Recommendations for Wrestlers and Other Power Athletes

- Weightlifters, gymnasts, and other athletes in sports requiring large muscular strength and power in relation to body mass often must lose body fat without negatively affecting exercise performance.
- Coaches must establish a safe minimal competitive body weight.
  - Determine percent body fat and fat-free body mass.
  - Calculate minimal weight at 5% fat for males and 12% for females.
  - The difference between present weight and minimal weight is the amount that can be lost.
Weight Gain

- Endurance training usually increases FFM only slightly, but the overall effect reduces body weight from the calorie-burning and possible appetite-depressing effects of this exercise type.
- Heavy muscular overload through resistance training, supported by adequate energy and protein intake (with sufficient recovery), greatly increases muscle mass and strength.
- A prudent recommendation increases daily protein intake to about 1.6 g/kg of body mass during the resistance-training period.
Factors affecting lean tissue synthesis in resistance training

1. Normal internal milieu for anabolic hormones (testosterone, growth hormone, insulin)
2. Type, intensity, frequency of training
3. Body size, composition, somatype
4. Previous training experience
5. Muscle fiber type
6. Genetics
7. Diet
8. Gender