Introduction

• Developing nations vs. developed nations
• Availability of food contributes to overweight and obesity
Energy Balance

• Intake
  ✓ Measured in kilojoules (kJ) or kilocalories (kcal) - food energy
  ✓ Determined by bomb calorimeter
  ✓ Nutrition Facts label, food composition tables, dietary analysis software
Energy Balance

- 24-Hour Energy Expenditure (EE)
  - Resting energy expenditure (REE)
  - Thermic effect of food
  - Physical activity

![Pie chart showing energy expenditure components: Resting Energy Expenditure 67%, Thermic Effect of Food 10%, and Physical Activity Energy Expenditure 23%]
Energy Balance

- Resting energy expenditure (REE)
  ✓ Sustain life, keep vital organs functioning
  ✓ 60-75% of EE, 1 kcal/kg body wt./hr
  ✓ See Box 14.2 for factors affecting REE
    - Lean body mass
    - Male sex
    - Body temperature
    - Age
    - Energy restriction
    - Genetics

- Basal energy expenditure (BEE)
  ✓ 10-20% lower than REE
  ✓ Difficult to measure
Energy Balance

- Thermic effect of food (TEF)
  - Measured for several hours postprandial
  - Digest, absorb, metabolize, store, and eliminate nutrients
  - 10% of EE
Energy Balance

- Physical Activity EE
  - Most variable
  - 20-25% of EE
  - Influenced by body weight, number of muscle groups used, intensity, duration and frequency of activity
Estimating Energy Expenditure

- Methods
  - Equations
  - Indirect calorimetry
  - Doubly-labeled water
  - Direct calorimetry
Estimating Energy Expenditure

• Equations for estimating EE
  ✓ Harris-Benedict
  ✓ WHO
  ✓ See Table 14.1 for equations
  ✓ IOM DRI – estimated energy requirement (EER) – see Table 14.2
    • Includes physical activity (PA) coefficient
    • Separate calculations for overweight adults and overweight children and adolescents – based on BMI
Estimating Energy Expenditure

- Indirect Calorimetry
  - Metabolic research or critically ill patients
  - Measures inspired and expired air by minute ventilation
  - EE proportional to oxygen consumption and carbon dioxide production
Estimating Energy Expenditure

• Doubly Labeled Water
  ✓“Gold standard”
  ✓2 stable isotope forms of water
  ✓Rate at which isotopes disappear is measured in urine over 2-week period
Estimating Energy Expenditure

- Direct Calorimetry
  - Chamber which measures heat expired through evaporation, convection, and radiation
  - Rarely available
Regulation of Energy Balance

- Interaction of nervous and endocrine systems
  ✓ Orexigenic
  ✓ Anorexigenic
  ✓ Adaptive thermogenesis
Regulation of Energy Balance

- Appetite stimulated by hypothalamus
  - Secretions of pancreatic and GI hormones
  - Increase and decrease appetite and food intake
  - Pradar-Willi syndrome
Regulation of Energy Balance

- Hormones affecting appetite & food intake
  - Insulin
  - Glucagon
  - Amylin
  - Cholecystokinin (CCK)
  - Glucagon like peptide-1
  - Peptide YY
  - Ghrelin
Adipose Tissue

- Adipocyte – fat cell; mostly TG
- Storage site - 90% energy reserves
- Other functions
- White fat (WAT) vs. brown fat (BAT)
- Lipogenesis
Newly imported triglycerides first form small droplets at the periphery of the cell, then merge with the large, central globule.

As the central globule enlarges, the fat cell membrane expands to accommodate its swollen contents.
Adipose Tissue

- Adiponectin and leptin stimulate storage
- Hypertrophy and hyperplasia of cells
- “Adiposity rebound”
Body Composition

- “Two compartment model” – fat vs. fat-free mass
  - Variety of methods (ch. 5)
- Use of height and weight – BMI commonly used to assess obesity
  - Does not directly measure fatness
  - Clinical judgment should be used
Body Composition

- **Body Mass Index (BMI)**
  - Obese $\geq 30$
  - See Box 14.3 – calculation and classifications
- **BMI percentiles**
  - CDC growth charts
  - Pediatric population
  - $\geq 95$th percentile = obesity
  - $\geq 85$th percentile = overweight
Body Fat Distribution

- Important predictor of health status
- Abdominal/central body fat
  - Apple, android
- Lower body fat
  - Hips and thighs, pear, gynoid
- Measured by waist circumference and waist-to-hip ratio
Body Fat Distribution

- Waist circumference
  ✓ Increased risk of type 2 DM, htn., dyslipidemia, CHD, metabolic syndrome
  ✓ > 40 in. males, > 35 in. females – “high risk”
Body Fat Distribution

• Waist-to-hip ratio (WHR)
  ✓ Waist circumference/hip circumference
  ✓ Disease risk increases with WHR > 0.95 in males and >0.8 in females

• Key concept: fat deep within abdomen and around intestines and liver increases disease risk
Epidemiology of Overweight & Obesity

• “Globesity,” “epidemic”
• In the U.S. - NHANES data
  ✓ Significant increases
  ✓ See figures 14.3, 14.4, 14.5, 14.6 for prevalence
• Canada
  ✓ Figures 14.7-14.12
• Europe
  ✓ Figures 14.13, 14.14
• By race, ethnicity, SES, age
  ✓ Figures 14.15, 14.16
Adverse Consequences

- “The age of caloric anxiety”
- Type 2 diabetes
- High blood pressure
- CHD
- Cancer
- Mortality
- See Box 14.4
Etiology of Obesity

• Chronic energy intake exceeding energy expenditure
• Key contributors:
  ✓ Medical disorders and treatment
  ✓ Genetics
  ✓ Obesigenic environment
Etiology of Obesity

- Medical disorders and treatment
  - Cushings syndrome, hypothyroidism, Prader-Willi
  - Pharmacological agents
  - Smoking cessation
  - Night eating syndrome
  - Binge eating
  - See Table 14.6
Etiology of Obesity

- Genetics
  - 40-50% of BMI explained by genetics
  - Influences taste, appetite, intake, expenditure, NEAT, storage
  - "Set-point" theory
  - Multiple genes
  - Predictive in families – parents & twins
    - 80% of offspring with 2 obese parents
    - 40% of offspring with 1 obese parent
    - MZ twins more likely than DZ twins
Etiology of Obesity

- Obesigenic environment
  - “Toxic food environment” – convenient availability of low-cost, tasty, energy-dense foods in large portions
  - Evidence supports low-energy-dense foods for satiety
    - Soups, fruits, vegetables, cooked whole grains
    - Barriers – cost and convenience
Treatment

- Two-step process
  - Assessment
  - Management
  - Figure 14.7 – NIH algorithm for treatment
Treatment

• Assessment
  ✓ BMI & waist circumference
  ✓ Current chronic diseases
  ✓ Diet and physical activity habits
  ✓ Patient’s readiness to lose weight
  ✓ Identify and address barriers, coping skills, self-efficacy
  ✓ Behavioral assessment - see Box 14.8
Treatment

• Management
  ✓ Use of recommended therapies
  ✓ Control of factors known to increase risk of morbidity
  ✓ Therapies include – diet, physical activity, behavioral therapy, bariatric surgery, pharmacologic treatment
  ✓ Lose 10% in 6 mo.
Treatment

- Nutrition therapy
  - Reduce intake 500-1000 kcal/d.
  - Lose 1-2 lbs./week
  - NIH low-kcalorie diet – Table 14.9
  - Minimize CVD risk factors – NCEP Therapeutic Lifestyle Changes diet
  - 1000-1200 kcal/d women, 1200-1600 kcal/d men minimum
  - Unclear whether altering macronutrient levels is beneficial
Treatment

• Physical Activity
  ✓ Crucial for weight maintenance
  ✓ Minimum 30-45 min moderate activity 3-5 days/week
  ✓ Initiate slowly and gradually
  ✓ Can be programmed or lifestyle activities
Treatment

• Behavior Therapy
  ✓ Techniques for identifying and overcoming barriers
    • Self-monitoring
    • Stimulus control
    • Rewards
Treatment

• Pharmacologic Treatment
  ✓BMI ≥ 30 or ≥ 27 with risk factors
  ✓Consider cost and side effects, and rebound weight gain
  ✓Long-term use
    • Sibutramine (Meridia)
    • Orlistat (Xenical)
  ✓Others for short-term use
Treatment

- Surgery
  - Bariatric surgery – BMI ≥ 40 or ≥ 35 with risk factors
  - **Roux-en Y gastric bypass**, vertical banded gastroplasty, adjustable band gastroplasty
  - See Fig. 14.18
  - Assess benefits vs. risks
  - Preoperative screening & education important
In vertical banded gastroplasty, the surgeon constructs a small stomach pouch and restricts the outlet from the stomach to the intestine.

In gastric bypass, the surgeon constructs a small stomach pouch and creates an outlet directly to the jejunum.
Eating Disorders

- Psychiatric condition characterized by severe disturbances in eating behaviors
  - Anorexia Nervosa (AN)
  - Bulimia Nervosa (BN)
  - Eating disorders not otherwise specified (EDNOS)

- Share common features
  - See Table 14.10
Eating Disorders

- Progression of disease
  - Dieting
  - Weight loss progression
  - Intense fear of gaining weight
  - Psychological, behavioral, medical problems persist
  - Sustained and obsessive pursuit
  - Etiology unknown
  - Character traits, environment and genetics play a role
Eating Disorders

- Anorexia Nervosa: “self-starvation”
  - Diagnostic criteria - Box 14.10
  - Restricting and binge eating/purging subtypes
  - Health complications – Table 14.11 & Fig. 14.20
    - Malnutrition (self-imposed)
    - Characteristic physical findings
    - Abnormal lab values
    - Reduced bone mineral density
Eating Disorders

• Bulimia Nervosa
  ✓ Diagnostic criteria – Box 14.10
  ✓ Recurrent episodes of binge eating and inappropriate compensatory behaviors
    • Purging and non-purging subtypes
  ✓ Vomiting, misuse of laxatives, diuretics, enemas vs. fasting or excessive exercising
  ✓ Typically of normal weight
Eating Disorders

- Bulimia Nervosa
  ✓ Health complications – see Table 14.12 and Fig. 14.21
  ✓ Signs:
    • Callous or scar on back of hands
    • Enlargement of salivary glands
    • Erosion of tooth enamel
    • Fluid and electrolyte imbalances
Esophagitis
Gastroesophageal reflux disease
Esophageal tearing

Constipation
Laxative dependence

Loss of dental enamel
Dental caries
Salivary gland enlargement

Syrup of ipecac can cause
- Cardiomyopathy
- Cardiac arrhythmias
- Electrocardiographic abnormalities

Callus on back of hand from using fingers to stimulate gag reflex to induce vomiting
Eating Disorders

• EDNOS
  ✓ See Diagnostic Criteria Box 14.10
  ✓ Atypical eating patterns and disordered eating but fail to meet criteria for AN or BN
  ✓ Binge-eating disorder
    • Lack of control over eating
    • Not followed by compensatory behavior
    • Most are obese
Eating Disorders

• Treatment
  ✓ Interdisciplinary team approach
  ✓ Focus on psychiatric management
  ✓ Emotional support
  ✓ Extensive counseling
  ✓ Outpatient... inpatient hospitalization
  ✓ Cognitive-behavioral therapy
  ✓ Pharmacological agents
Eating Disorders

• Nutrition Therapy
  ✓ Assess nutrition status
  ✓ Address food and nutrition issues
  ✓ And associated behaviors
  ✓ Monitor response to treatment
  ✓ Implement nutrition component
  ✓ Provide ongoing support
Eating Disorders

• Nutrition Therapy - AN
  ✓ Restore patient’s weight to 90% of expected
  ✓ Cessation of weight loss
  ✓ Improvement in eating behaviors
  ✓ Slow progression of weight gain and kcal
  ✓ Vitamin and mineral supplements
  ✓ Supervise meals
  ✓ Closely monitor serum electrolytes
Eating Disorders

- Nutrition Therapy - BN
  - Reduce binge/purge cycle
  - Normalize eating patterns
  - Regular meals and snacks
  - Provide order to mealtimes
  - Food intake sufficient to prevent hunger
  - Inclusion of “forbidden” or “feared” foods
  - Education and support