Chapter 8
Energy Balance

**Energy in = Energy out**

Energy in = food
- beverages
- alcohol

Energy out = basal metabolism
- physical activity
- food digestion

Energy Balance

Excess energy is stored as fat

Fat is used for energy between meals

1 lb of body fat = 3500 kcalories

The composition of weight gained or lost is normally about 75% fat and 25% lean.

In starvation, losses of fat and lean are about equal

Energy In: The kCalories Foods Provide

Food Composition

A bomb calorimeter is an instrument that measures the heat energy released when foods are burned.

Direct calorimetry measures the heat energy released.

Indirect calorimetry measures the amount of oxygen consumed and carbon dioxide expelled.

Physiological fuel value is the difference between the number of kcalories measured with calorimetry and the number of kcalories that the human body derives from a food.

Food Intake

**Appetite:**

- The response to the sight, smell, thought, or taste that initiates or delays eating

**Hunger:**

Physiological drive for food

Irritating feeling that motivates you to eat

Physiological response to nerve signals and chemical messengers

Hypothalamus

Food Intake

Influenced by:

- Nutrients in bloodstream
- Size and composition of preceding meal
- Customary eating patterns
- Climate
- Exercise
- Hormones
- Illness

Eat in periodic “batches”; about 4 hour intervals
Food Intake

**Satiation:**
- Feeling of satisfaction and fullness during a meal
- Signals us to stop eating

**Satiety:**
- Feeling of satisfaction after a meal and inhibits eating
- Maintains the signal NOT to eat

Energy In: Food Composition

Food Intake

**Overriding Hunger and Satiety Signals:**
Other signals trigger eating:
- stress, anxiety, sight, smell, time of day, availability, boredom
Other signals trigger satiety:
- anorexia, stress, excitement

Food Intake

**Sustaining Satiation and Satiety:**
Protein: is most satiating
High fiber: fills the stomach and delays absorption; also satiating
Fat:
- entices us to eat more
- as a weak satiating effect in the stomach
- stronger satiating effect in small intestine

Food Intake

**Hypothalamus-Message Central:**
Control center for eating
Integrates messages
Energy intake, expenditure, storage
receives messages from brain, mouth, GI tract, liver

**Neuropeptide Y:**
- stimulates appetite, decreases energy expenditure, and increases fat storage

Energy Out: The kCalories the Body Expends

Energy expenditure includes:
- basal metabolic activities
- physical activity
- thermic effect of food
- adaptive thermogenesis.

These energy requirements differ from person to person and are affected by age, gender, weight, and height.
The intensity and duration of physical activity also make a difference.

**Components of Energy Metabolism**

**Basal Metabolism:**
Energy the body spends for maintenance activities
Metabolic activities
All basic processes of life
Exp: maintaining body temperature
    making new RBC’s
    heart beating
    breathing (inhaling and exhaling)
2/3 of energy spent per day supports basal metabolism
Rate varies between people
Components of Energy Expenditure – Basal Metabolism

Components of Energy Metabolism

Physical Activity:
Most variable and changeable component
Energy needed depends on:
    muscle mass
    body weight
    activity
The larger the muscle mass and heavier the weight, the more energy is expended

Energy Expenditure

Thermic Effect of Foods:
The energy required to process food
Estimated at 10% of energy intake

Adaptive Thermogenesis:
Adjustment in energy expenditure related to dramatically changed circumstances
Variable and specific to individuals; not used in calculating energy needs

Estimating Energy Requirements
Gender- women have a lower BMR than men
Growth- active growth raises your BMR
Age- reduction in energy expenditure is about 5% per decade

Physical Activity
Body Composition and body size
BMR is higher in tall people
The more a person weighs, the more energy is spent on BMR

Energy Expenditure
The BMR begins to decrease in early adulthood at a rate of 2% per year
Voluntary activity also declines

Overall total decrease in energy expenditure is 5% per decade

Estimating Energy Expenditure
Men 19 years and older:
EER= \{ 662 - (9.53 \times \text{age}) \} + \text{PA} \times \{ (15.91 \times \text{wt}) + (539.6 \times \text{ht}) \}

Women 19 years and older:
**Body Composition**  
**Body Weight, Body Composition, and Health**  
**Defining Healthy Body Weight**  
**The Criterion of Fashion**  
What is “Ideal”?—  
-Movies, magazines and television  
Perceived body images vs actual  
Half of preteen girls and one third of preteen boys are unsatisfied with their weight and body shape  
**Dangerously Thin**  
**Defining Healthy Body Weight**  
**Defining Healthy Body Weight**  
How much should I weigh?  
**The Criterion of Health—**  
Good health and longevity supersedes appearance.  
Ideally, a person needs enough fat to meet basic needs, but not so much as to incur health risks  
Fat distribution pattern that is associated with a low risk of illness and premature death  
A medical history that reflects the absence of risk factors associated with obesity such as elevated blood cholesterol, blood glucose or blood pressure  
**BMI: Relative weight for height**  
**Defining Healthy Body Weight**  
**BMI**  
**Distribution of Body Weights in U.S. Adults**  
**BMI Silhouettes**  
**Body Fat and Its Distribution**  
Important information for disease risk  
**How much of weight is fat?**  
**Where is fat located?**  
**Ideal amount of body fat depends on person**  
**General disease risk levels**  
Young men: 22%; Men over 40: 25%  
Young women: 32%; Women over 40: 35%  
**Body Fat and Its Distribution**  
Normal weight man: 13 to 21% body fat  
Normal weight woman: 23 to 31% body fat  
**Athletes: Men:** 5 - 10%  
**Women:** 15 -20%  
**Body Fat and Its Distribution**  
**Body Fat Distribution**  
**Central Obesity**  
Intra-abdominal fat, (visceral fat), independent of BMI, is associated with increased risk of:
Heart disease
Stroke
Diabetes
Hypertension
Gallstones

**Waist Circumference**
Practical indicator of fat distribution and abdominal fat
High risk of central obesity related health problems:
Men: waist circumference > 40
Women: waist circumference >35

The Criterion of Health
Ideal: Have enough fat to meet basic needs but not so much as to incur health risks.

**Health Problems Typically Develop When:**

<table>
<thead>
<tr>
<th>Body Fat</th>
<th>Age</th>
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<tbody>
<tr>
<td>&gt;22%</td>
<td>&lt;40 year old Male</td>
</tr>
<tr>
<td>&gt;25%</td>
<td>&gt;40 year old Male</td>
</tr>
<tr>
<td>&gt;32%</td>
<td>&lt;40 year old Female</td>
</tr>
<tr>
<td>&gt;35%</td>
<td>&gt;40 year old Female</td>
</tr>
</tbody>
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Body Fat and Its Distribution
Methods Used to Access Body Fat
Health Risks Associated With Body Weight and Fat

**Underweight:**
- Fighting against wasting diseases
- Menstrual irregularities and infertility
- Osteoporosis and bone fractures

BMI and Mortality
Health Risks of Overweight

**Overweight:**
Risks include:
Diabetes
Hypertension
Cardiovascular Disease
Sleep Apnea
Osteoarthritis
Respiratory problems
Gallbladder Disease
Infertility
Complications in Pregnancy and surgery

Health Risks
300,000 people die annually from obesity related illnesses
Mortality increases as excess weight increases
People with BMI greater than 35 are twice as likely to die from heart disease
Weight gain of more than 20# between early and middle adulthood increases risk
Health Risks of Overweight

**Cardiovascular Disease:**
Central obesity may increase the risk of stroke and heart attacks

**Diabetes:**
Type II Diabetes 3X more likely in obese people
Type II Diabetes often has central obesity

**Cancer:**
Relationship is unclear between cancer risk and increased body weight or weight gain

Health Effects

**Metabolic Syndrome:** a cluster of at least 3 of the following risk factors
- High Blood Pressure
- High Glucose
- High triglycerides
- Low HDL
- High Waist Circumference

Increases the risk for diabetes, hypertension, atherosclerosis

End of Chapter 8

Energy Balance

Eating Disorders

Highlight 8

Eating Disorders
Anorexia nervosa,
Bulimia nervosa
Binge-eating disorders.
The causes include a combination of sociocultural, psychological, and perhaps neurochemical factors.
Athletes are among the most likely group to develop eating disorders.

The Female Athlete Triad
Disordered eating habits can develop.
Desire to improve performance and excel
Enhance aesthetic appeal of their performance
Attempt to meet unsuitable weight standards
Unsupervised dieting
The Female Athlete Triad
Osteoporosis
Stress hormones compromise bone health.
Stress fractures are common bone injuries.
Adequate calcium is recommended.

Other Dangerous Practices of Athletes
Food and fluid restrictions to make weight in wrestling
Muscle dysmorphia is a psychiatric disorder concerning obsession with building body mass.

Preventing Eating Disorders in Athletes
Follow USDA Food Guide for food servings.
Eat frequently, especially healthy snacks.
Establish a reasonable weight goal.
Allow reasonable time to achieve the weight goal.
Join a weight maintenance support group.

Anorexia Nervosa
Mostly females
Distorted body image
Often unresolved family conflicts
Strong parental control
Use food to gain control
Strong discipline
Extremely knowledgeable regarding kcalories
Extreme exercise
Starvation/Malnutrition

Anorexia Nervosa
Starvation
Metabolic rate slows
Heart muscle weakens
Bleed pressure falls
Mineral imbalance
Impaired immune system
Anemia
Deteriorated gastrointestinal tract
Anorexia Nervosa
Treatment is multidisciplinary
Physician, nurse, psychiatrists, family therapists, and dietitians
Food and weight
Relationships with self and others

Bulimia Nervosa
Weight fluctuates approximately 10 #
Educated
Weight is close to IBW
Depressed and has low self esteem
Obsessed with body weight and food
Consumes food for emotional comfort
Secret binge-eating or extremely large portions, often at night, lasts for and hour or more
Followed by purging
May use an emetic (stimulate vomiting) or a laxative (stimulate diarrhea)
Feelings of shame or guilt

Bulimia Nervosa
Treatment of Bulimia Nervosa
Weight maintenance
Regular exercise
Counseling

Binge-Eating Disorder
An unspecified eating disorder sharing some of the characteristics of anorexia nervosa and bulimia nervosa yet does not meet the criteria for diagnosis.

Lack of self-control over eating with binges
Consuming large quantities of food, eating quickly, feeling uncomfortably full, eating alone, and feeling disgusted or guilty

Marked distress
Occurrence of two times per week for six months

Typically do not purge

Eating Disorders in Society
Occur more commonly in developed nations where food and money are plentiful
Learning to appreciate the uniqueness of oneself may be a key to prevention.

The Latest and Greatest Weight-Loss Diet - Again
The claims and truths of diet fads

The Latest and Greatest Weight-Loss Diet - Again
High-protein, low carbohydrate diets
Don’t count calories
Satisfy hunger
Follow a plan
Limit choices

The Latest and Greatest Weight-Loss Diet - Again
High-protein, low carbohydrate diets
Too much fat
Too much protein
Too little everything else
The body’s perspective

High Protein Low Carbohydrate Diets
1. Too much fat and protein
2. Not enough fiber, vitamins, minerals
3. Too little variety
4. Unbalanced nutrition
5. Side effects:
   - Nausea
   - Fatigue
   - Low blood pressure
   - Bad breath
   - Constipation
   - Pregnant women-fetal harm, stillbirth

6. High satiety index

Estimated Energy Requirements (EER)