Chapter 14

Nutrition in Physical Activity
Fitness

What is fitness? Are you “physically fit”?

The characteristics that enable the body to perform physical activity

The ability to meet routine physical demands with enough reserve energy to rise to a sudden challenge.

You are prepared to meet mental and emotional
Fitness

- More than 40% of adults in the US are not regularly active
- 13% are completely inactive (sedentary)
- Physical inactivity is linked to:
  - Heart disease
  - Cancer
  - Stroke
  - Diabetes
  - Hypertension
- $77 billion dollars per year is spent on health care costs attributed to inactivity in the US
Benefits of Fitness

- Restful sleep
- Nutritional health
- Optimal body composition
- Optimal bone density
- Resistance to infectious disease
- Strong circulation and lung function
- Lower risk of some types of cancers (colon, breast)
- Lower risk of cardiovascular disease
- Lower risk of diabetes- Type II
- Lower risk of gall bladder disease
- Lower risk of anxiety and depression
- Strong self image
- Longer life; higher quality life in later years
Benefits of Fitness

- Dietary Guidelines recommends at least 150 minutes a week of moderately intense activity (walking or jogging)
- Or-75 minutes per week of vigorous-intensity aerobic activity
- Aerobic activity should be at least 10 minutes for short bouts of activity
Levels of Physical Activity Intensity Compared

<table>
<thead>
<tr>
<th>Level of Intensity</th>
<th>Breathing and/or Heart Rate</th>
<th>Perceived Exertion (on a Scale of 0 to 10)</th>
<th>Talk Test</th>
<th>Energy Expenditure</th>
<th>Walking Pace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Little to no increase</td>
<td>&lt;5</td>
<td>Able to sing</td>
<td>&lt;3.5 kcal/min</td>
<td>&lt;3 mph</td>
</tr>
<tr>
<td>Moderate</td>
<td>Some increase</td>
<td>5 or 6</td>
<td>Able to have a conversation</td>
<td>3.5 to 7 kcal/min</td>
<td>3 to 4.5 mph</td>
</tr>
<tr>
<td>Vigorous</td>
<td>Large increase</td>
<td>7 or 8</td>
<td>Conversation is difficult or “broken”</td>
<td>&gt;7 kcal/min</td>
<td>&gt;4.5 mph</td>
</tr>
</tbody>
</table>

# American College of Sports Medicine (ACSM) Guidelines for Physical Fitness

<table>
<thead>
<tr>
<th>Type of Activity</th>
<th>Cardiorespiratory</th>
<th>Strength</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic activity</strong> that uses large-muscle groups and can be maintained continuously</td>
<td>Resistance activity that is performed at a controlled speed and through a full range of motion</td>
<td>Stretching activity that uses the major muscle groups</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>5 to 7 days per week</td>
<td>2 to 3 nonconsecutive days per week</td>
<td>2 to 7 days per week</td>
</tr>
<tr>
<td>Intensity</td>
<td>Moderate (equivalent to walking at a pace of 3 to 4 miles per hour)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Enough to enhance muscle strength and improve body composition</td>
<td>Enough to feel tightness or slight discomfort</td>
</tr>
<tr>
<td>Duration</td>
<td>At least 30 minutes per day</td>
<td>2 to 4 sets of 8 to 12 repetitions involving each major muscle group</td>
<td>2 to 4 repetitions of 15 to 30 seconds per muscle group</td>
</tr>
<tr>
<td>Examples</td>
<td>Running, cycling, dancing, swimming, inline skating, rowing, power walking, cross-country skiing, kickboxing, water aerobics, jumping rope; sports activities such as basketball, soccer, racquetball, tennis, volleyball</td>
<td>Pull-ups, push-ups, sit-ups, weightlifting, pilates</td>
<td>Yoga</td>
</tr>
</tbody>
</table>

<sup>a</sup>For those who prefer vigorous-intensity aerobic activity such as walking at a very brisk pace (>4.5 mph) or running (>5 mph), a minimum of 20 minutes per day, 3 days per week is recommended.

Developing Fitness

Components of Fitness

- **Flexibility**: Allows joints to move with less chance of injury
- **Muscle strength and muscle endurance**: Allows muscles to work harder and longer without fatigue
- **Cardiorespiratory endurance**: Supports ongoing action of the heart and lungs
Fitness

• Goals
  • Meet everyday demands of life
  • Reasonable body weight & body composition

• Developing Fitness
  • The Overload Principle – to slightly increase comfortable capacity in each area; asking a little more from your body in each training workout
    • This is also called the progressive overload principle.
    • Increase frequency – how often an activity is performed
    • Increase intensity – the degree of exertion while exercising
    • Increase duration – the length of time
Fitness

- Developing Fitness
  - The Body’s Response to Physical Activity
    - **Hypertrophy** is muscle gain in size and strength, the result of repeated work.
    - **Atrophy** is muscle loss in size and strength, the result of lack of activity.
    - Work different muscle groups from day to day
Developing Fitness

- Minimizing risk of overuse injuries
  - Be active all week
  - Use proper equipment and attire
  - Use proper form
  - Include warm-up and cool-down activities
  - Challenge your strength and endurance a few times a week
  - Pay attention to body signals
  - Work out wisely
Developing Fitness

- Cautions on starting
  - Risk factors include:
    - Family history of heart disease
    - Cigarette smoking
    - Hypertension
    - Serum cholesterol > 200
    - Diabetes
    - Sedentary lifestyle
    - Obesity
Cardiorespiratory Endurance

- **Cardiorespiratory Endurance** - the length of time a person can remain active with an elevated heart rate
  - Is Aerobic
  - Improves your ability to sustain vigorous activity
  - Improves capacity of heart and lungs to deliver oxygen
  - Oxygen is delivered more efficiently
Cardiorespiratory Endurance

- **Cardiorespiratory conditioning:**
  - Cardiac output is increased and enhances oxygen delivery
  - Heart stronger—pumps more blood per beat.
  - Resting heart rate decreases.
    - Average RHR for adults = 70 beats/min
    - Cardiac conditioning: 50 BPM
  - Breathing becomes more efficient
  - Improves circulation
  - Reduces blood pressure
Cardiorespiratory Endurance

- To improve cardiorespiratory endurance:
  - Work 20 min or longer
  - Use large muscle groups (legs, buttocks, abdomen)
  - Train at intensity to increase heart rate.
Fitness

- Resistance Training
  - Develops muscle mass, strength, power, and endurance
  - Prevents and manages cardiovascular disease
  - Enhances psychological well-being
  - Maximizes and maintains bone mass
  - Improve posture and reduce back injury
  - Enhances performance in other sports
- Muscle strength- heavy weights with low repetitions.
- Muscle endurance-lighter weights with more repetitions.
# A Sample Balanced Fitness Program

<table>
<thead>
<tr>
<th><strong>TABLE 14-3</strong> A Sample Balanced Fitness Program</th>
</tr>
</thead>
</table>

**Monday, Tuesday, Wednesday, Thursday, Friday:**
- 5 minutes of warm-up activity
- 30–60 minutes of aerobic activity
- 10 minutes of cool-down activity and stretching

**Tuesday, Thursday, Saturday:**
- 5 minutes of warm-up activity
- 30 minutes of resistance training
- 10 minutes of cool-down activity and stretching

**Saturday and/or Sunday:**
- Sports, walking, hiking, biking, or swimming
Energy Systems of Physical Activity

- **ATP** - Adenosine triphosphate
  - High energy compound
  - Present all body tissues all the time
  - Delivers energy instantly
  - ATP splits, energy is released
Energy Systems

- **CP**- Creatine Phosphate
  - High energy compound stored in the muscles
  - Used anaerobically (without oxygen)
  - Splits to release phosphate to make more ATP
  - Reservoir of energy to maintain supply of ATP
  - Provides energy for short bursts of activity
  - Produced during rest
Energy Systems of Physical Activity

- Energy yielding nutrients
  - When body demands are higher - you breakdown **CHO, PRO, and FAT** to generate ATP (energy)
- Muscles use a mixture of fuels
- Full mix depends on:
  - Diet
  - Intensity and duration of activity training
  - Degree body is conditioned to perform the activity
Energy Systems of Physical Activity

- High intensity, short duration:
  - Anaerobic: depend on glucose for fuel.

- Low-moderate intensity, long duration:
  - Aerobic: depend on fat for fuel
## Fuels Used for Activities of Different Intensities & Durations

<table>
<thead>
<tr>
<th>Activity Intensity</th>
<th>Activity Duration</th>
<th>Preferred Fuel Source</th>
<th>Oxygen Needed?</th>
<th>Activity Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8 to 10 sec</td>
<td>ATP-CP (immediate availability)</td>
<td>No (anaerobic)</td>
<td>100-yard dash, shot put</td>
</tr>
<tr>
<td>Very high</td>
<td>20 sec to 3 min</td>
<td>ATP from carbohydrate (lactate)</td>
<td>No (anaerobic)</td>
<td>¼-mile run at maximal speed</td>
</tr>
<tr>
<td>High</td>
<td>3 min to 20 min</td>
<td>ATP from carbohydrate</td>
<td>Yes (aerobic)</td>
<td>Cycling, swimming, or running</td>
</tr>
<tr>
<td>Moderate</td>
<td>More than 20 min</td>
<td>ATP from fat</td>
<td>Yes (aerobic)</td>
<td>Hiking</td>
</tr>
</tbody>
</table>

<sup>a</sup>All levels of activity intensity use the ATP-CP system initially; extremely intense short-term activities rely solely on the ATP-CP system.
Glucose use in Physical Activity

- During exercise:
  - Liver breaks down glycogen releases glucose into the bloodstream
  - Muscles use this glucose as well as their own glycogen to fuel their work
  - The more glycogen muscles store, the longer the activity can last
  - When glycogen is depleted, the muscles become fatigued
Effect of Diets on Physical Endurance

- Diet content reflects glycogen storage.
- High carbohydrate diet enhances endurance by enlarging glycogen stores.

![Graph showing the effect of diets on physical endurance.](image)
Glucose Use in Physical Activity

- The intensity of the activity impacts how long glycogen will last
  - Greater intensity activity will use glycogen more quickly (running)
  - Less intense aerobic activity - slower glycogen use (jogging)
    - Use glucose and fatty acids
- Glycogen depletion usually occurs within 2 hours from onset of intense activity
Glucose use in Physical Activity

- **Lactic Acid:**
  - Produced when rate of the activity exceeds the body's ability to supply adequate oxygen to the tissues, which occurs in high intensity exercise.

Cori-cycle:
- Lactate $\rightarrow$ Liver $\rightarrow$ Glucose $\rightarrow$ Muscles.
Glucose use in Physical Activity

- Duration of the activity affects glycogen use:
  - 20 minutes of moderate activity-
    - uses mostly glycogen
    - muscle glycogen, then liver glycogen
  - After 20 minutes of moderate activity-
    - use more fat and less glycogen
  - Eventually will deplete muscle and glycogen stores.
Glucose Use in Physical Activity

Glucose depletion:
- Usually occurs within 2 hours from onset of intense activity
- Brings nervous system to a halt- “hitting the wall”
- To prevent- maximize glucose supply
  - Eat high CHO diet (about 8 grams/kg body weight)
  - Take glucose periodically (juice, sports drinks)
  - Eat high CHO foods after the activity (60 grams)
  - Train muscles to store glycogen
Glucose Use in Physical Activity

- **Glucose during Activity:**
  - Endurance activities > 1 hour
    - Eat 30-60 grams of carbohydrate per hour
    - Sport drinks during the activity

- **Glucose after activity:**
  - High CHO food eaten within 2 hours following activity enlarges glycogen stores
Glucose Use in Physical Activity

- **60 gram CHO Snacks**
  - 16 oz sport drink and bagel
  - 16 oz milk and 4 oatmeal cookies
  - 8 oz pineapple juice and a granola bar

- **Training affects glycogen use:**
  - Muscles that consistently deplete stores- Adapt to store more.
  - Conditioned muscles rely less on glycogen and more on fat.
Fat Use in Physical Activity

Duration of activity
- After 20 minutes of sustained, moderate activity, fat is used as the major fuel.

Intensity
- As intensity increases, use less fat as fuel

Training
- Aerobic training allows body to adjust to using fat as fuel
  - Muscles make more and larger mitochondria
Protein Use in Physical Activity

- **Protein use in muscle building:**
  - Synthesis occurs between activities,
    - Not during the activity
  - Active muscle building training - can add 1/4 - 1 ounce muscle mass each day
  - High quality protein consumption following exercise enhances muscle protein synthesis
Protein Use in Physical Activity

- **Protein as Fuel:**
  - Contributes about 10% of total fuel
- **Diet affects protein use:**
  - Adequate energy and carbohydrate
    - Diet rich in carbohydrate use less protein for fuel
Protein Use in Physical Activity

- **Intensity and Duration:**
  - Protein needs are higher for endurance and strength athletes

- **Training:**
  - Higher degree of training-less protein used

- **Protein recommendations:**
  - Needs are higher for athletes in training
  - Need adequate carbohydrate intake
## Recommended Protein Intakes for Athletes

<table>
<thead>
<tr>
<th>Recommendations (g/kg/day)</th>
<th>Protein Intakes (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td><strong>Females</strong></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>RDA for adults</td>
<td>0.8</td>
</tr>
<tr>
<td>Recommended intake for power (strength or speed) athletes</td>
<td>1.2–1.7</td>
</tr>
<tr>
<td>Recommended intake for endurance athletes</td>
<td>1.2–1.4</td>
</tr>
<tr>
<td>US average intake</td>
<td>102</td>
</tr>
</tbody>
</table>

Vitamins and Minerals

Supplements:
- Do not enhance performance of nourished person.
- Deficiencies will impede performance

Iron Deficiency:
- At risk-physically active young women
  - Losses-sweat, menstruation, poor intake
- Vegetarian athletes
- Iron deficiency anemia
  - Low hemoglobin-less oxygen to cells for energy
- Sports anemia
The need for water surpasses the need for any other nutrient

Losses in sweat and breathing
- Body cools itself via sweat
- Dehydration is a concern
- Water loss of 2% of body weight can reduce muscle capacity
- Water loss of 7% - collapse
Fluids and Electrolytes

**Fluid replacements:**
- Endurance athletes-lose 1.5 liters *per hour*
- Hydrate before activity
- Rehydrate during and after the activity
- Best fluid:
  - Non-competitive - water
  - Endurance - water and carbohydrate
# Hydration Schedule for Physical Activity

## Table 14-6: Hydration Schedule for Physical Activity

<table>
<thead>
<tr>
<th>When to Drink</th>
<th>Amount of Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 3 hr before activity</td>
<td>2 to 3 c</td>
</tr>
<tr>
<td>15 min before activity</td>
<td>1 to 2 c</td>
</tr>
<tr>
<td>Every 15 min during activity</td>
<td>½ to 1 c (Drink enough to minimize loss of body weight, but don’t overdrink.)</td>
</tr>
<tr>
<td>After activity</td>
<td>2 c for each pound of body weight lost$^a$</td>
</tr>
</tbody>
</table>

$^a$Drinking 2 cups of fluid every 20 to 30 minutes after exercise until the total amount required is consumed is more effective for rehydration than drinking the needed amount all at once. Rapid fluid replacement after exercise stimulates urine production and results in less body water retention.

Fluids and Electrolytes

Electrolyte loss replacement:

- Na, K, Cl, Mg
- Eat regular diet
- Event >1 hour—may need sports drink

Poor beverage choices:

  Caffeine containing beverages, alcohol
Fluids and Electrolytes to Support Activity

- Sports drinks
  - Hydration is critical to optimal performance
    - Water is best for most people
  - Sport drinks offer the following
    - Fluid
    - Glucose
    - Sodium and electrolytes
    - Good taste
Choosing a Diet to Support Fitness

- Water:
  - Drink before you feel thirsty

- Nutrient Density:
  - High vitamins & minerals
  - High Carbohydrate-60-70%
  - Moderate fat- 20-35%
  - Adequate Protein: 10-20%
Choosing A Diet

**Breakfast**
1 c shredded wheat with low-fat milk and banana. 
2 slices whole-wheat toast with jelly. 
1 1/2 c orange juice.

**Lunch**
2 turkey sandwiches. 
1 1/2 c low-fat milk. 
Large bunch of grapes.

**Snack**
3 c plain popcorn. 
A smoothie made from: 
1 1/2 c apple juice. 
1 1/2 frozen banana.

**Dinner**
Salad: 1 c spinach, carrots, and mushrooms with 1/2 c garbanzo beans, 1 tbsp sunflower seeds, and 1 tbsp ranch salad dressing. 
1 c spaghetti with meat sauce. 
1 c green beans. 
1 corn on the cob. 
2 slices Italian bread. 
4 tsp butter. 
1 piece angel food cake with fresh strawberries and whipping cream. 
1 c low-fat milk.

**Total kcal: 3000**
63% kcal from carbohydrate 
22% kcal from fat 
15% kcal from protein

All vitamin and mineral intakes exceed the RDA for both men and women.
Meals for Competition

**Pregame meal:**
- High fluids, light, easy to digest
- 300-800 kcal
- High CHO, **Low Fiber**, low fat
- Meal should end 3-4 hours before competition.

**Postgame meal:**
- High CHO
- Low protein, fat, fiber
Choosing A Diet

- Pregame meals

300-kcalorie meal
1 large apple
4 saltine crackers
1½ tbs reduced-fat peanut butter

500-kcalorie meal
1 large whole-wheat bagel
2 tbs jelly
1½ c low-fat milk

750-kcalorie meal
1 large baked potato
2 tsp margarine
1 c steamed broccoli
1 c mixed carrots and green peas
5 vanilla wafers
1½ c apple or pineapple juice
Nutrient-Dense Snacks for Athletes and Active People

One ounce of almonds provides protein, fiber, calcium, vitamin E, and healthy unsaturated fats. Similar choices include other nuts or trail mix consisting of dried fruit, nuts, and seeds.

Low-fat Greek yogurt contains more protein per serving than regular yogurt, but a little less calcium. A small amount of fresh fruit adds fiber and vitamins. A similar choice is low-fat cheese paired with fresh fruit.

Low-fat milk or chocolate milk together with fig bars or oatmeal-raisin cookies offer protein and fiber. A similar choice is whole-grain cereal with low-fat milk.

Popcorn offers fiber and a fruit smoothie quenches thirst and provides valuable vitamins. A similar choice is pretzels and fruit juice.
Supplements as Ergogenic Aids
Ergogenic Aids

- Protein Powders
- Amino Acid Supplements
- Carnitine
- Vitamin E
- Chromium Picolinate
- Complete Nutrition Supplements
- Creatine Monohydrate
- Caffeine
- Anabolic Steroids
- DEHA
- Human growth Hormone
Dietary Supplements that Perform as Claimed

- Caffeine
  - Enhances endurance, alertness, and reduces fatigue
  - Restricted substance by NCAA

- Creatine
  - Enhance performance during high intensity activity (weight lifting, sprinting)
  - Potential risks (weight gain, kidney disease)

- Sodium bicarbonate
  - Maintenance of muscle pH levels
  - Buffers the acid and CO2 in muscles
Dietary Supplements that Do Not Perform as Claimed

- Carnitine
  - Facilitates transfer of fatty acids across mitochondria membranes
  - Supplementation does not increase muscle carnitine or enhance exercise performance.

- Chromium Picolinate
  - Essential mineral in carbohydrate and lipid metabolism
  - Supplementation has no effect on strength, lean body mass, or body fat.
# Ergogenic Aids

## TABLE H14-1: Substances Promoted as Ergogenic Aids

<table>
<thead>
<tr>
<th>Dietary Supplement</th>
<th>Claims</th>
<th>Research Findings</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arginine (an amino acid)</td>
<td>Increases muscle mass</td>
<td>Ineffective</td>
<td>Generally well tolerated; may be harmful to people with heart disease</td>
</tr>
<tr>
<td>Boron (trace mineral)</td>
<td>Increases muscle mass</td>
<td>Ineffective</td>
<td>No adverse effects reported with doses up to 10 mg/day; should be avoided by those with kidney disease or women with hormone-sensitive conditions</td>
</tr>
<tr>
<td>Coenzyme Q10 (carrier in the electron transport chain)</td>
<td>Enhances exercise performance</td>
<td>Ineffective</td>
<td>Mild indigestion</td>
</tr>
<tr>
<td>Gamma-oryzanol (plant sterol)</td>
<td>Increases muscle mass; mimics anabolic steroids without known side effects</td>
<td>Ineffective</td>
<td>No adverse effects reported with short-term use; no long-term safety studies</td>
</tr>
<tr>
<td>Ginseng (plant)</td>
<td>Enhances exercise performance</td>
<td>Ineffective</td>
<td>No adverse effects reported with moderate doses; large doses may cause hypertension, nervousness, sleeplessness, acne, edema, headache, and diarrhea; those with diabetes should be aware of hypoglycemic effects; should be avoided by those at risk for estrogen-related cancers, those with blood clotting issues, and pregnant or lactating women</td>
</tr>
<tr>
<td>Glycerol (a 3-carbon molecule that is part of triglycerides and phospholipids)</td>
<td>Improves hydration during exercise; regulates body temperature during exercise; enhances exercise performance</td>
<td>Inconsistent findings for improving hydration and regulating body temperature; ineffective for enhancing exercise performance</td>
<td>May cause nausea, headaches, and blurred vision; should be avoided by those with edema, congestive heart failure, kidney disease, hypertension, and other conditions that may be aggravated by fluid retention</td>
</tr>
<tr>
<td>HMB (beta-hydroxy-beta-methylbutyrate) (a metabolite of the branched-chain amino acid leucine)</td>
<td>Increases muscle mass and strength</td>
<td>Inconsistent findings</td>
<td>No adverse effects with short-term use and doses up to 76 mg/kg of body weight</td>
</tr>
<tr>
<td>Pyruvate (a 3-carbon sugar)</td>
<td>Enhances exercise endurance</td>
<td>Ineffective</td>
<td>No long-term safety studies; digestive problems with short-term use (&lt;6 weeks)</td>
</tr>
<tr>
<td>Ribose (a 5-carbon sugar)</td>
<td>Increases ATP production and enhances high-intensity exercise performance</td>
<td>Ineffective</td>
<td>Naturally generated in body; submitted to USDA to become a Generally Recognized As Safe food additive (pending)</td>
</tr>
<tr>
<td>Royal jelly (produced by bees)</td>
<td>Enhances stamina and reduces fatigue</td>
<td>No studies on human beings to date</td>
<td>No adverse effects with doses up to 12 mg/day; should be avoided by those with a history of asthma or allergic reactions</td>
</tr>
<tr>
<td>Sodium bicarbonate (baking soda)</td>
<td>Reduces lactic acid and delays fatigue; enhances power and strength</td>
<td>May reduce lactic acid and muscle fatigue; more research is needed for definitive conclusions</td>
<td>Gastrointestinal distress including diarrhea, cramps, and bloating; should be avoided by those on sodium-restricted diets</td>
</tr>
</tbody>
</table>

Dangerous, Banned, or Illegal Supplements

- Anabolic Steroids
  - Illegal
  - Authorities ban use
  - Derived from male sex hormone – testosterone
    - Development of male characteristics
    - Lean body mass
  - Dangerous side effects on the body and the mind
Hormonal Supplements

- **DHEA (dehydroepiandrosterone) and Androstenedione**
  - Hormones that are precursors to testosterone
  - No evidence to support claims
  - Short-term effects are identified

- **Human Growth Hormone (hGH)**
  - Used to build lean tissue and increase height if still growing
  - Extremely high cost
  - Many adverse side effects
<table>
<thead>
<tr>
<th>Table H14-2 Anabolic Steroids: Side Effects and Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mind</strong></td>
</tr>
<tr>
<td>• Extreme aggression with hostility (&quot;steroid rage&quot;); mood swings: anxiety; dizziness; drowsiness; unpredictability; insomnia; psychotic depression; personality changes; suicidal thoughts</td>
</tr>
<tr>
<td><strong>Face and Hair</strong></td>
</tr>
<tr>
<td>• Swollen appearance; greasy skin; severe, scarring acne; mouth and tongue soreness; yellowing of whites of eyes (jaundice)</td>
</tr>
<tr>
<td>• In females, male-pattern hair loss and increased growth of face and body hair</td>
</tr>
<tr>
<td><strong>Voice</strong></td>
</tr>
<tr>
<td>• In females, irreversible deepening of voice</td>
</tr>
<tr>
<td><strong>Chest</strong></td>
</tr>
<tr>
<td>• In males, breathing difficulty, breast development</td>
</tr>
<tr>
<td>• In females, breast atrophy</td>
</tr>
<tr>
<td><strong>Heart</strong></td>
</tr>
<tr>
<td>• Heart disease; elevated or reduced heart rate; heart attack; stroke; hypertension; increased LDL, reduced HDL</td>
</tr>
<tr>
<td><strong>Abdominal Organs</strong></td>
</tr>
<tr>
<td>• Nausea; vomiting; bloody diarrhea; pain; edema; liver tumors (possibly cancerous); liver damage, disease, or rupture leading to fatal liver failure; kidney stones and damage; gallstones; frequent urination; possible rupture of aneurysm or hemorrhage</td>
</tr>
<tr>
<td><strong>Blood</strong></td>
</tr>
<tr>
<td>• Blood clots; high risk of blood poisoning; those who share needles risk contracting HIV (the AIDS virus) or other disease-causing organisms; septic shock (from injections)</td>
</tr>
<tr>
<td><strong>Reproductive System</strong></td>
</tr>
<tr>
<td>• In males, permanent shrinkage of testes; prostate enlargement with increased risk of cancer; sexual dysfunction; loss of fertility; excessive and painful erections</td>
</tr>
<tr>
<td>• In females, loss of menstruation and fertility; permanent enlargement of external genitalia; fetal damage, if pregnant</td>
</tr>
<tr>
<td><strong>Muscles, Bones, and Connective Tissues</strong></td>
</tr>
<tr>
<td>• Increased susceptibility to injury with delayed recovery times; cramps; tremors; seizure-like movements; injury at injection site</td>
</tr>
<tr>
<td>• In adolescents, failure to grow to normal height</td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td>• Fatigue; increased risk of cancer</td>
</tr>
</tbody>
</table>

Table H14-2, p. 488
<table>
<thead>
<tr>
<th>Mind</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Extreme aggression with hostility (&quot;steroid rage&quot;); mood swings; anxiety; dizziness;</td>
</tr>
<tr>
<td>drowsiness; unpredictability; insomnia; psychotic depression; personality changes,</td>
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<tr>
<td>suicidal thoughts</td>
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<tr>
<td><strong>Face and Hair</strong></td>
</tr>
<tr>
<td>• Swollen appearance; greasy skin; severe, scarring acne; mouth and tongue soreness;</td>
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<tr>
<td>yellowing of whites of eyes (jaundice)</td>
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<tr>
<td>• In females, male-pattern hair loss and increased growth of face and body hair</td>
</tr>
<tr>
<td><strong>Voice</strong></td>
</tr>
<tr>
<td>• In females, irreversible deepening of voice</td>
</tr>
<tr>
<td><strong>Chest</strong></td>
</tr>
<tr>
<td>• In males, breathing difficulty, breast development</td>
</tr>
<tr>
<td>• In females, breast atrophy</td>
</tr>
<tr>
<td><strong>Heart</strong></td>
</tr>
<tr>
<td>• Heart disease; elevated or reduced heart rate; heart attack; stroke; hypertension;</td>
</tr>
<tr>
<td>increased LDL; reduced HDL</td>
</tr>
</tbody>
</table>
Abdominal Organs

- Nausea; vomiting; bloody diarrhea; pain; edema; liver tumors (possibly cancerous); liver damage, disease, or rupture leading to fatal liver failure; kidney stones and damage; gallstones; frequent urination; possible rupture of aneurysm or hemorrhage

Blood

- Blood clots; high risk of blood poisoning; those who share needles risk contracting HIV (the AIDS virus) or other disease-causing organisms; septic shock (from injections)

Reproductive System

- In males, permanent shrinkage of testes; prostate enlargement with increased risk of cancer; sexual dysfunction; loss of fertility; excessive and painful erections
- In females, loss of menstruation and fertility; permanent enlargement of external genitalia; fetal damage, if pregnant

Muscles, Bones, and Connective Tissues

- Increased susceptibility to injury with delayed recovery times; cramps; tremors; seizure-like movements; injury at injection site
- In adolescents, failure to grow to normal height

Other

- Fatigue; increased risk of cancer
End of Chapter 14

Nutrition in Fitness