CARDIOVASCULAR DISEASE, DIABETES, AND CHRONIC LUNG DISEASES

Chapter 14
Cardiovascular Disease

- *Cardiovascular disease (CVD)*: any disease involving the heart and/or blood vessels
- Currently the leading cause of death in the United States, accounting for one-third of all deaths
- CVD is a general term for diseases that include heart attack, stroke, peripheral artery disease, congestive failure, and others
- The disease process underlying many forms of CVD is *atherosclerosis*, or hardening of the arteries
Deaths from Types of CVD in the U.S., 2013

- Coronary heart disease: 49.0%
- Stroke: 16.4%
- Other: 16.2%
- Diseases of the arteries: 3.4%
- High blood pressure: 7.8%
- Heart failure: 7.2%
Atherosclerosis

- A common form of arteriosclerosis that involves a thickening or hardening of the arteries due to the buildup of fats and other substances
  - Starts with damage to the inner lining of vessels and the formation of a fatty streak—accumulation of lipoproteins within the walls of an artery
  - Once an injury exists on the artery, white blood cells, collagen, and other proteins are formed, creating plaque (accumulation of debris in an artery wall)
    - Results in slow blood flow, reducing the amount of blood to the tissues
    - Plaque can break off and completely block artery
Atherosclerosis

Coronary arteries

Damaged inner lining
Cholesterol-filled cells
Plaque and fatty deposits
Coronary Heart Disease and Heart Attack

- *Coronary heart disease (CHD):* atherosclerosis of the coronary arteries, which can result in a heart attack
- CHD is the leading form of all cardiovascular diseases
- An estimated 16.3 million Americans are living with CHD
- Those who survive a heart attack are often left with damaged hearts and significantly altered lives
Coronary Heart Disease and Heart Attack

- **Ischemia**: insufficient supply of oxygen and nutrients to tissue, caused by narrowed or blocked arteries

- **Myocardial infarction**: lack of blood flow to the heart muscle with resulting death of heart tissue, often called a heart attack

- **Coronary thrombosis**: blockage of a coronary artery by a blood clot that may cause sudden death

- **Angina**: pain, pressure, heaviness, or tightness in the center of the chest caused by a narrowed coronary artery
Arrhythmias and Sudden Cardiac Death

- **Arrhythmia**: irregular or disorganized heartbeat
- Normal adult heart rate is 60–100 beats/minute
- **Ventricular fibrillation**: type of arrhythmia in which the ventricles contract rapidly and erratically, causing the heart to quiver or “tremor” rather than beat
- **Sudden cardiac death**: abrupt loss of heart function caused by an irregular or ineffective heartbeat
Stroke

- A stroke or cerebrovascular accident (CVA) occurs when blood flow to the brain or part of the brain is blocked
  - Fourth leading cause of death in the United States; leading cause of severe, long-term disability
  - Ischemic stroke: caused by blockage in a blood vessel in the brain (accounts for 87% of all strokes)
    - Thrombus
    - Embolism
  - Hemorrhagic stroke: caused by rupture of a blood vessel in the brain, with bleeding into brain tissue
  - Transient ischemic attacks (TIAs) “ministrokes”; periods of restricted blood supply that produce the same symptoms as a stroke
Congestive Heart Failure

- Condition in which the heart is not pumping the blood as well as it should, allowing blood and fluids to back up in the lungs.
- Can develop after a heart attack or as a result of hypertension, heart valve abnormality, or disease of the heart muscle.
- Person with this condition experiences difficulty breathing, shortness of breath, coughing, fatigue, and confusion.
Other Cardiovascular Diseases

- Heart valve disorders
  - Most common is the mitral valve prolapse
- Congenital heart disease
  - Structural defect at birth
- Peripheral vascular disease (PVD)
  - Atherosclerosis in the arms and legs
- Cardiomyopathy
  - Disease of the heart muscle
    - Dilated
    - Hypertrophic
Major Controllable Factors in Cardiovascular Health

- Tobacco use
- Blood pressure levels
- Cholesterol levels
- Physical activity
- BMI
- Blood glucose levels
- Diet
Blood Pressure

- Force exerted by blood against artery walls

- Determined by two forces:
  - Pressure when the heart contracts (systolic; top number)
  - Pressure in the arteries when the heart is relaxed (diastolic; bottom number)

- Hypertension: blood pressure that is forceful enough to damage artery walls

- Untreated high blood pressure/hypertension:
  - Can weaken and scar the arteries and make the heart work harder
  - Can cause heart attacks, strokes, kidney disease, peripheral artery disease, and blindness
### Table 14.1  Blood Pressure Guidelines

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic (mmHg)</th>
<th>Diastolic (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Less than 120 <em>and</em></td>
<td>Less than 80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120–139 <em>or</em></td>
<td>80–89</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>140–159 <em>or</em></td>
<td>90–99</td>
</tr>
<tr>
<td>Stage 2</td>
<td>160 and above <em>or</em></td>
<td>100 and above</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total cholesterol (mg/dL)</th>
<th>Desirable</th>
<th>Borderline high</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200–239</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240 or greater</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LDL cholesterol (mg/dl)</th>
<th>Near or above optimal</th>
<th>Optimal</th>
<th>Borderline high</th>
<th>High</th>
<th>Very high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100–129</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130–159</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160–189</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190 or greater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HDL cholesterol (mg/dl)</th>
<th>Low (undesirable)</th>
<th>High (desirable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 or greater</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Triglycerides (mg/dl)</th>
<th>Normal</th>
<th>Borderline high</th>
<th>High</th>
<th>Very high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150–199</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200–499</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 or greater</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Achieving a goal of less than 70 is an option if there is a high risk for heart disease.

Contributing Factors in Cardiovascular Health

- **Triglyceride levels**
  - Levels of these blood fats should be less than 150 to achieve desired levels

- **Alcohol intake**
  - Heavy drinking (more than 3 drinks/day) can damage the heart
  - Light drinking (less than 2 drinks/day) can increase HDL levels, therefore protecting against heart disease and stroke risk

- **Psychosocial factors**
  - Personality, chronic stress, socioeconomic status, depression, and social support
Noncontrollable Factors in Cardiovascular Health

- Age
- Gender
- Genetics and family history
- Ethnicity and race
- Postmenopausal status
Testing and Treatment for Heart Disease

◦ Diagnostic testing
  ◦ Electrocardiogram (ECG or EKG)
  ◦ Echocardiogram (sound waves)
  ◦ Exercise stress test

◦ Medical management
  ◦ Anti-arrhythmics
  ◦ Anti-anginals
  ◦ Anti-coagulants

◦ Surgical management
  ◦ Angioplasty (balloon catheter)
  ◦ Coronary artery bypass grafting
Management of Stroke

- **Management**
  - If thrombotic, thrombolytic medications can dissolve clot and restore blood flow to the brain
  - If hemorrhagic, depends on the underlying cause of the bleed; sometimes surgery is necessary
  - Rehabilitation, usually including physical therapy, an important component
Areas of Interest for Future CVD Research

- Researchers are looking at how the following are associated with CVD:
  - Low levels of vitamin D
  - High blood levels of homocysteine, an amino acid
  - Metabolic syndrome
  - Inflammation
  - High levels of C-reactive protein in the blood
  - Infections that may cause atherosclerotic plaques to break free
  - Lower birth weight
Diabetes

- Most common disorder of the endocrine or metabolic system
- Rates of diabetes have doubled every 15 years since the 1950s
- All types of diabetes result in elevated blood glucose levels due to a disruption in the production or use of insulin
Insulin and Glucose Uptake

Normal
Insulin binds to receptors on the surface of a cell and signals special transporters in the cell to transport glucose inside.

Type 1 diabetes
The pancreas produces little or no insulin. Thus, no signal is sent instructing the cell to transport glucose, and glucose builds up in the bloodstream.

Type 2 diabetes
The pancreas produces too little insulin and/or the body’s cells are resistant to it. Some insulin binds to receptors on the cell’s surface, but the signal to transport glucose is blocked. Glucose builds up in the bloodstream.
Type-1 Diabetes

- Caused by the destruction of insulin-producing cells in the pancreas by the immune system
- Insulin must be provided from an external source to keep blood glucose levels under control
- Onset usually occurs before age 20
- Probably a result of a combination of genetic, autoimmune, and environmental factors
- Physical activity is an important component of control and reduction in long-term complications
Type-2 Diabetes

- Caused by insulin resistance in the insulin receptors in body cells
- Pancreas responds by increasing production of insulin, but eventually cannot keep up
- Accounts for 90–95% of all diabetes cases
- Incidence rising in parallel with obesity levels
  - Visceral fat and lack of physical activity are strong indicators of risk
- Onset is usually gradual
- Prediabetes: fasting blood glucose levels between 100 and 126 mg/dl
  - Dietary changes, exercise, weight loss can prevent or delay onset
Metabolic Syndrome

- Set of conditions that significantly increases the risk for developing diabetes and other health complications

- Diagnosed if three of the following present:
  - Fasting glucose level ≥ 100
  - HDL cholesterol < 40 in men; < 50 in women
  - Triglycerides ≥ 150
  - Waist circumference ≥ 40" for men; ≥ 35" for women
  - Systolic blood pressure ≥ 130 and diastolic blood pressure ≥ 85
Type-2 Diabetes Detection and Treatment

- Blood test to look at fasting glucose level
- Treatment
  - Lifestyle modification
  - Oral medications
  - Insulin replacement
- Exercise particularly important
- Monitored by blood test called the hemoglobin A1c test
Gestational Diabetes

- Develops in 2–10% of pregnancies
  - Hormonal changes affect the body’s response to insulin
  - Higher risk for pregnancies after age 35
- In 5–10% of cases, diabetes becomes an ongoing condition
- Women with a history of gestational diabetes are at a higher risk of developing diabetes in the next 10–20 years
Chronic Lung Diseases

- Also known as chronic lower respiratory diseases
- Third leading cause of death in the U.S.
- Two most common forms:
  - Asthma
    - Large genetic component
  - Chronic obstructive pulmonary disease (COPD)
    - More typical in older adults
- Both are triggered by smoking, infection, and pollution
The Respiratory System
Asthma

○ Chronic inflammation, obstruction, and constriction of the airways, causing wheezing, coughing, chest tightness, and shortness of breath

○ Attack occurs in response to a trigger: an allergen or an irritant in the air

○ Diagnostic categories:
  ○ Intermittent: no symptoms between episodes
  ○ Mild persistent: symptoms a few times a week
  ○ Moderate: daily symptoms limit normal activity
  ○ Severe: daily symptoms place extreme limits on normal activity
Asthma

- **Bronchodilators:** quick-relief medications used during an attack to reduce symptoms
  - Delivered through an inhaler
- **For long-term control:**
  - An inhaled steroid that works within the bronchioles to reduce inflammation
  - Avoidance of common triggers such as tobacco smoke, allergens, and air pollution
    - Flu shots recommended if viruses and infections are triggers
COPD

- Tends to develop from cumulative damage to airways and alveoli; primary cause is smoking
- Chronic bronchitis: persistent inflammation of the bronchioles; excess mucus
  - Bronchial congestion and a chronic cough
- Emphysema: alveoli become less elastic, and walls between alveoli are damaged or destroyed
  - Person is breathless and gasps for air
  - Strains the heart
  - Cannot be reversed; supplemental oxygen may be necessary at later stages
Preventing Chronic Diseases

- Eat a heart-healthy diet
- Avoid overweight and obesity
- Don’t smoke, and avoid secondhand smoke
- Be physically active
- Limit alcohol consumption
- Maintain healthy blood pressure levels
- Maintain healthy lipid levels
- Maintain healthy blood glucose levels
- Manage stress, and take care of your mental, emotional, and social health