

Chapter 18 Diet and Health



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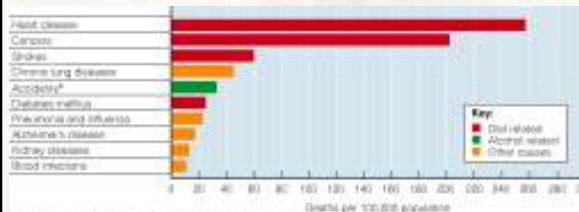
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Nutrition and Chronic Disease

- Healthy People 2010
 - Disease prevention/health promotion objectives
 - Increase the quality and years of healthy life
 - Eliminate health disparities
- Obesity and chronic disease
- Physical inactivity and chronic disease

Nutrition And Chronic Disease

Ten leading causes of death in the U.S. (2002)



*These are age adjusted to allow for a fair comparison of mortality among groups and over time.
 *Data exclude still and hospice deaths and deaths from homicide or suicide among people ages 10-24.
 *Excludes homicide, suicide, motor vehicle crashes, and firearm deaths. *Excludes homicides, suicides, motor vehicle crashes, and firearm deaths.
 © 2003, Division of National Center for Health Statistics, 2002

Nutrition and Chronic Diseases

- Four of the top ten causes of death are related to diet.
- There are also genetic and lifestyle risk factors that are important and related to chronic disease.
- Many of the nutritional factors in the treatment of chronic disease are interrelated.

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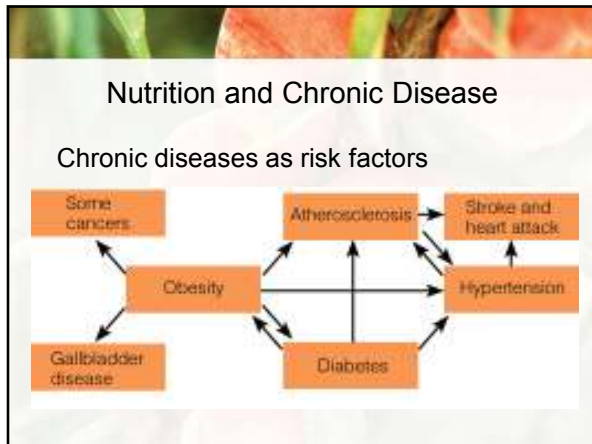
Diet Risk Factors

Chronic Diseases	Diet Risk Factors					Other Risk Factors				
	Overweight/obesity	High fat intake	High sugar intake	High sodium intake	High intake of (BHA) trans-fatty acids	Age	Gender	Family history	Physical inactivity	Stress
Cancer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hypertension	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diabetes (type 2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Obesity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Atherosclerosis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stroke	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chronic kidney disease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dental and oral disease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Nutrition and Chronic Disease: Risk Factors

- **Modifiable**
 - Physical inactivity
 - Stress
 - Smoking
 - Drug/alcohol abuse
 - Diet, intake of:
 - Calories
 - Fat
 - Fiber
 - Sugar
 - Salt
 - Vitamins, minerals
- **Non-modifiable**
 - Age
 - Gender
 - Family history





- ### Genetics and Disease
- Disease risk factors
 - Genetics, environment, nutrition, lifestyle
 - Human Genome Project
 - International effort designed to help understand the genetics of diseases
 - Spearheaded by NIH

- ### Genetics and Disease
- DNA and genes
 - Genetic code for making proteins
 - Mutations: error in genetic code
 - Nutritional genomics
 - Influence of diet on gene expression

Cardiovascular Disease (CVD)

- Leading cause of death in U.S. and Canada
- Major type: atherosclerosis

Cardiovascular Diseases (CVD)

- CVD
 - Diseases of the heart and blood vessels
- **Coronary heart disease (CHD)**
 - Most common form of CVD
 - Damage occurs when coronary arteries become narrow, occluded
 - Usually involves:
 - **Atherosclerosis** in the coronary arteries
 - **Hypertension (HTN)**
- Atherosclerosis and HTN exacerbate each other

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    graph TD
      CVD --> CHD
      CHD --> Atherosclerosis
      Atherosclerosis <--> HTN
  
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- ### Cardiovascular Disease
- Risk Factors for Coronary Heart Disease
 - Diet and physical activity are modifiable risk factors.
 - Age, Gender, and Family History
 - Cannot change these factors
 - Men higher risk than women
 - Men older than 45 years of age
 - Women older than 55 years of age
 - Immediate family history of premature heart disease
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Cardiovascular Disease

- Risk Factors for Coronary Heart Disease
 - High LDL and Low HDL Cholesterol
 - LDL
 - Excess LDL (low-density lipoproteins) become available for oxidation, high risk
 - Risk factors for LDL cholesterol
 - Desirable: <100 mg/dL
 - Above optimum level: 100-129 mg/dL
 - Borderline: 130-159 mg/dL
 - High: 160-189 mg/dL
 - Very High: >190 mg/dL

Cardiovascular Disease

- High LDL and Low HDL Cholesterol
 - HDL
 - HDL (high-density lipoproteins) represent cholesterol being carried back to the liver, reduced risk
 - Risk factors for HDL cholesterol
 - Desirable: ≥60 mg/dL
 - Borderline: 59-40 mg/dL
 - High: <40 mg/dL

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Cardiovascular Disease

- High LDL and Low HDL Cholesterol
 - Total cholesterol
 - Desirable levels at < 200 mg/dL
 - Borderline levels at 200-239 mg/dL
 - High levels at ≥ 240 mg/dL

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Cardiovascular Disease

- Recommendations for Reducing Coronary Heart Disease Risk
 - Cholesterol Screening – at least two times at least one week apart
 - Lifestyle Changes
 - Balance energy intake with energy needs.
 - Include lean meats, vegetables, and low-fat milk products.
 - Limit foods with high concentrations of saturated fatty acids (< 7% of total kcalories) and *trans*-fatty acids (< 1% of total kcalories).
 - Limit foods with a high content of cholesterol (< 300 mg/day).
 - Choose foods high in soluble fiber: vegetables, fruits, and whole grains.

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Cardiovascular Disease

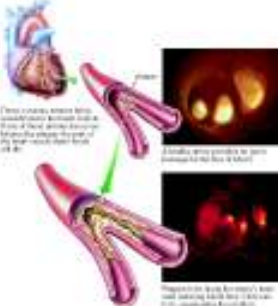
- Lifestyle Changes
 - High-potassium, low-sodium foods
 - Limit sodium to 2,300 mg/day.
 - Limit intake of added sugar.
 - Consume fatty fish at least twice a week for omega-3 fatty acids.
 - Consume foods with plant sterols or stanols added.
 - Use soy products in place of animal foods that are high in saturated fat and cholesterol.
 - Limit alcohol consumption to 1 drink/day for women or 2 drinks/day for men.
 - Exercise at least 30 minutes most days of the week to expend 2,000 kcalories weekly.
 - Reduce exposure to tobacco smoke.

Atherosclerosis

- Definition
 - Role of cholesterol
 - Role of inflammation
- Risk Factors

How Atherosclerosis Develops

- **Atherosclerosis**
 - “Hardening of the arteries”
 - Fibrous plaques
 - Soft fatty streaks accumulate in arterial walls
 - Enlarge and harden as they fill with lipids and minerals
 - Become encased in fibrous connective tissue, form plaques
 - Plaques stiffen the arteries and narrow passages through them



Causes of Atherosclerosis


- A complex **inflammatory response** to tissue damage
 - **C-reactive protein (CRP)**, a marker of inflammation
 - **LDL oxidation**, involved in fatty streak development
- Damage to cells lining blood vessels caused by:
 - High LDL cholesterol
 - Hypertension
 - Diabetes
 - Toxins from cigarette smoking
 - Elevated homocysteine
 - Some viral and bacterial infections

Causes of Atherosclerosis, con't

- Damage elicits inflammatory response
 - Macrophages sent in to repair damage
 - LDL particles trapped in blood vessel walls
 - Inflammatory response generates free radicals
 - Oxidizes LDL particles
 - Engulfed by macrophages
 - Macrophages swell, become foam cells
 - Accumulate, become fatty streaks

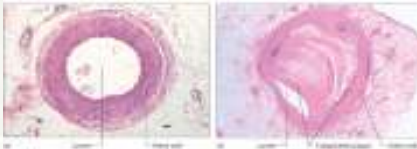
Blood Clots and Atherosclerosis

- **Blood clots**
 - Occur when fibrous coating of plaque torn
 - Platelets (in blood) respond,
 - Cover damaged area, form clot
- **Thrombosis**
 - Clot sticks to plaque in artery, gradually grows larger
 - Can restrict or close off a blood vessel
- **Embolism**
 - Clot breaks free from artery wall, travels in circulatory system
 - Can lodge in small artery and shut off blood flow
- **Eicosanoids (PG, LT)** control action of platelets
 - Omega 3 fatty acids, when plentiful in the diet, make more of the eicosanoids that favor heart health




Blood Pressure and Atherosclerosis

- Arteries narrowed by plaques, clots, or both
- Narrowed arteries have restricted blood flow
- Heart generates more pressure to deliver blood to tissues
- High blood pressure
 - Further damages artery walls
 - Plaques, clots more likely to form at damage points
 - A self-accelerating process



Result of Atherosclerosis

- If blood flow to the heart is cut off, area of heart muscle dies
 - **Heart attack**
- Restricted blood flow to the brain causes transient ischemic attack
 - **Stroke**
- Healthy People 2010:
 - Reduce CHD deaths
 - Reduce stroke deaths



Results of High Blood Pressure

- **Heart failure**
 - Strain on pump can enlarge and weaken it
 - Gradually fails
- **Aneurysm**
 - Constant elevated pressure in artery
 - Gradually balloons out, bursts
 - Massive bleeding, death
- **Kidney disease**
 - Heart unable to adequately pump enough blood through kidneys

Modifiable Risk Factors for Hypertension

- **Modifiable**
 - Smoking
 - ↑ heart's workload
 - Alcohol
 - > 2 drinks/day ↑ bp
 - Interferes with drugs
 - High blood lipids
 - Diabetes
 - ↑ insulin signals kidneys to retain Na⁺
 - Obesity
 - ↑ adipose tissue means more capillaries to pump blood through

Non-modifiable Risk Factors for Hypertension

- **Non-modifiable**
 - Gender
 - Men
 - Postmenopausal women
 - Age
 - Begins to rise at 50 y
 - Heredity
 - Men, < 55 y
 - Women, < 65 y
 - Race
 - African American

Recommendations for Reducing Hypertension Risk

- **Healthy People 2010:**
 - Reduce proportion of adults with high blood pressure
 - Increase proportion who are taking action to control it
- Find out whether you have it
 - Diet, lifestyle modifications for pre- and stage 1 hypertension

Recommendations for Reducing Hypertension Risk, con't

- Weigh control
- Physical activity
- Alcohol
- Dietary sodium
- DASH diet

DASH Diet

Dietary Approaches to Stop Hypertension

- Key foods:
 - Fruits
 - Vegetables
 - Low fat dairy
 - Nuts
- Key components:
 - High in Ca, K, Mg
 - Low in Na
 - Low fat, sat fat
 - High fiber


Cancer

Cancer is not a single disorder

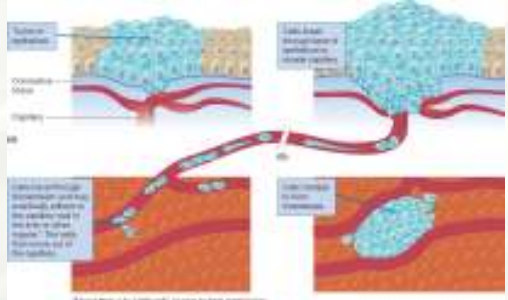
- Many different kinds of malignancies
- Each with different characteristics
- Occur in different locations of body
- Take different courses
- Require different treatments

• **Classifications:**

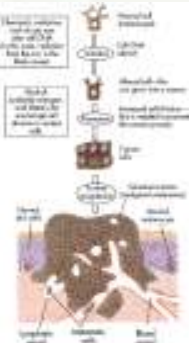
- Adenomas
- Carcinomas
- Gliomas
- Leukemias
- Lymphomas
- Melanomas
- Sarcomas



Cancer



How Cancer Develops

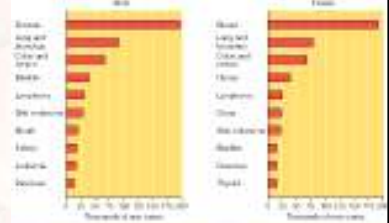


• **Carcinogenesis** is a multi-step event:

- **Initiation** – alteration of DNA, gene mutation
- **Promotion** – cell division increases
- **Progression** – cancer cells proliferate, form mass large enough to significantly affect body functions

How Cancer Develops


- Cancers are described by
 - Location
 - Size
 - Extent



Ten Leading Sites of New Cases of Cancer for Men and Women in U.S., 2001


Cancer Deaths

Cancer deaths for males	Cancer deaths for females
Stomach—115	Stomach—20
Lung—215	Lung—85
Colon and rectum—215	Stomach—105
Leukemia and lymphomas—215	Veter—15
Pancreas—215	Esophagus and stomach—15
Uterus and ovaries—105	Melanoma and lymphomas—105
Urinary—65	Pancreas—65
Prostate—115	Cervical cancer—115
All others (lung, oral and skin)—215	Ovary—65
	Uterus and ovaries—20
	All others (e.g., breast, oral and bladder)—220



How Cancer Develops

- Genetic factors
 - All cancers have a genetic component, mutation
 - Some are genetically inherited, predisposition
- Immune factors
 - Ineffective immune system may not recognize tumor cells as foreign, unchecked growth
 - Aging affects immune function, increased cancer incidence
 - Immune suppression drugs may increase cancer risk
- Environmental factors
 - Exposure to radiation and sun
 - Water and air pollution
 - Smoking



How Cancer Develops: Dietary Factors

- Diet may be linked to 30% of cancer cases
- **Cancer initiators**
 - ↓ intake of green, yellow F&V along with alcohol, tobacco use ↑ head/neck cancers
 - Alcohol intake ↑ mouth, throat, breast cancers
 - Grilled foods (vaporized fats create carcinogens)
 - Red meat consumption associated with colon cancer
 - Acrylamide, starches baked/fried at high temperatures

How Cancer Develops: Dietary Factors

- **Cancer promoters**
 - High fat diets (animal studies)
 - Meat fats ↑ risk of prostate cancer
 - Breast cancer and fat??
 - High calorie diets promote cancer
 - Saturated, trans-fats may promote cancer
 - Omega-3 fatty acids from fish may be protective
- **Cancer anti-promoters**
 - Diet high in fruits and vegetables
 - Fiber-rich diets protect against colon cancer
 - Phytochemicals activate enzymes that destroy carcinogens

Cancer

- Risk factors
- Reducing the risk
 - Eat a variety of healthful foods
 - emphasis on plant sources
 - Adopt a physically active lifestyle
 - Maintain a healthful weight throughout life
 - If you drink alcoholic beverages, limit consumption

Broccoli and other cruciferous vegetables contain phytochemicals that may help protect against cancer.	Eating a variety of fruits and vegetables provides a wide range of phytochemicals that may help protect against cancer.	Eating a variety of meats, including fish, poultry, and lean meats, provides a source of protein and other nutrients.	Drinking alcohol in moderation may help protect against cancer.
Drinking wine in moderation may help protect against cancer.	Eating tomatoes and other fruits and vegetables provides a wide range of phytochemicals that may help protect against cancer.	Eating citrus fruits and other fruits and vegetables provides a wide range of phytochemicals that may help protect against cancer.	Drinking tea in moderation may help protect against cancer.
Eating a variety of grains, including whole grains, provides a source of fiber and other nutrients.	Eating a variety of herbs and spices provides a wide range of phytochemicals that may help protect against cancer.	Eating a variety of nuts provides a source of healthy fats and other nutrients.	Eating a variety of berries provides a wide range of phytochemicals that may help protect against cancer.

Recommendations for Reducing Cancer Risk

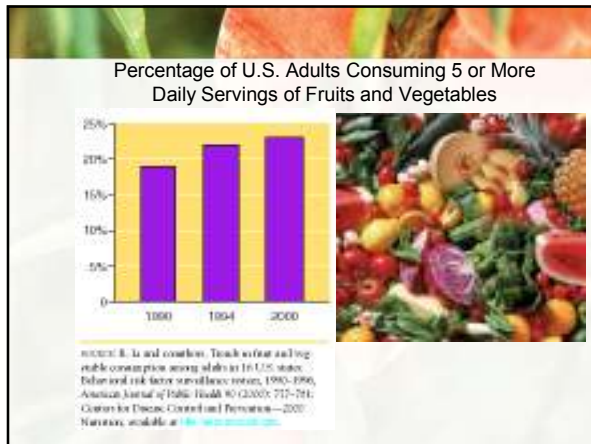
American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer:

- Eat a variety of healthful foods
 - With an emphasis on plant sources
- Adopt a physically active lifestyle
- Maintain a healthful weight throughout life
- If you drink alcoholic beverages, limit consumption
- Do not smoke or use tobacco in any form

www.cancer.org

Recommendations for Reducing Cancer Risk

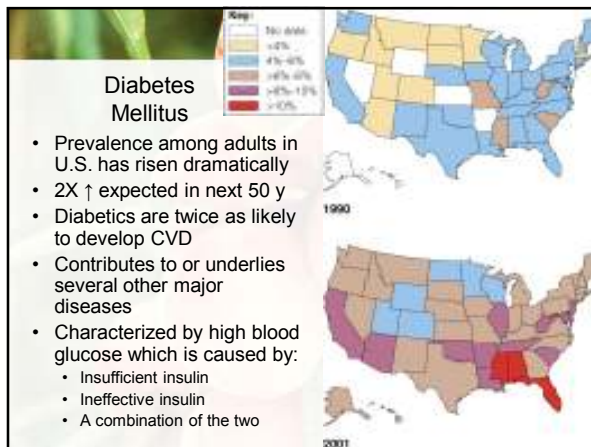
- www.aicr.org



Diabetes

- Definition and types
 - Type 1
 - Type 2
 - Pre-diabetes
 - Gestational
- Risk factors
- Reducing the risk
- Management
 - Diet
 - Physical activity
 - medications

Picture Source: Aster Health Labs at <http://asterhealth.com/health/insulin.jpg>



Features of Diabetes: Type 1 vs. Type 2

	Type 1 Diabetes	Type 2 Diabetes
Other names	Insulin-dependent diabetes ¹ mellitus (IDDM)	Noninsulin-dependent diabetes mellitus (NIDDM)
Average age of onset	<20 (mean age, 12)	10-19; >40
Associated conditions	Viral infection, heredity	Obesity, heredity, aging
Insulin required?	Yes	Sometimes
Cell response to insulin	Normal	Resistant
Symptoms	Relatively severe	Relatively moderate
Prevalence in diabetic population	5 to 10%	90 to 95%

¹The terms insulin-dependent diabetes (IDDM) and noninsulin-dependent diabetes (NIDDM) have been eliminated from use by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. The committee states that these terms have been confusing and often result in classifying patients based on treatment rather than the cause of the disease.

How Diabetes Develops

- **Type 1:**
 - Autoimmune disorder
 - Immune cells attack insulin-producing cells in pancreas
- **Type 2:**
 - Insulin-producing cells progressively lose function with age
 - Almost everyone with Type 2 is overweight
 - Closely associated with obesity and inactivity
 - Obese require more insulin to maintain normal blood glucose
 - As body fat increases, insulin receptors diminish in number or function
 - Impaired glucose tolerance

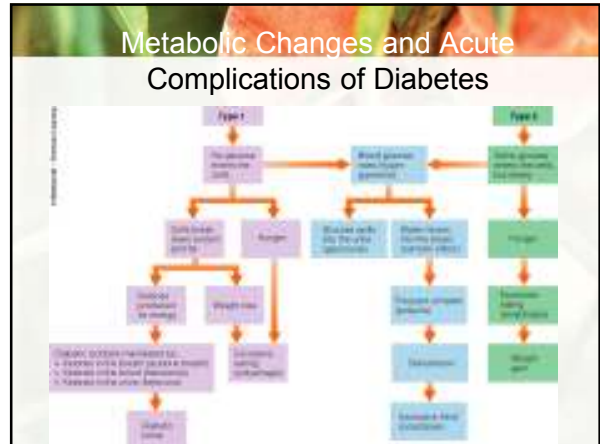
Diabetes Mellitus

- Recommendations for Diabetes
 - Dietary Fat
 - Saturated fat: <7% of total calories
 - Cholesterol: <200 mg/day
 - Protein
 - No need to modify intake as long as there is normal kidney function
 - 15-20% of total calories
 - Alcohol Use in Diabetes
 - Alcohol should be used in moderation.
 - One drink/day for women two drinks/day for men

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Metabolic Syndrome

- Cluster of three of the following risk factors:
 - Excess abdominal fat
 - High blood glucose
 - High serum triglycerides
 - Low HDL cholesterol
 - Hypertension



Effects of Chronically Elevated Blood Glucose

- Altered glucose metabolism in every cell
- Eyes (lens cells)
 - XS glucose converted to sugar alcohols
 - Toxicity, cell distention
 - Distended cells cause blurry vision
- Glycoprotein production
 - XS glucose attaches to amino acid in protein
 - Protein cannot function normally
- Structures of blood vessels and nerves damaged
- Poor circulation combined with XS glucose in blood and urine leads to infections

Complications of Diabetes

- Diseases of the large blood vessels
 - **Atherosclerosis**
 - Tends to develop early
 - Progresses rapidly
 - More severe in diabetics
 - 80% of diabetics die of CVD
- Diseases of the small blood vessels (capillaries)
 - Loss of kidney function, retinal degeneration
 - 85% of diabetics have impaired kidneys, vision
- Diseases of the nerves
 - Nerve tissues deteriorate, loss of sensation
 - Undetected injury and infection lead to tissue death (gangrene)
 - Delayed gastric emptying; irregular nutrient absorption

Recommendations for Diabetes


- **Diet**
 - Maintain consistent CHO intake throughout day
 - Lower fat intake if blood lipids elevated
 - Be careful: ↓ fat usually means ↑ carbohydrates
 - Fat calories should come from unsaturated sources
 - Moderate weight loss (Type 2)
 - Improves insulin resistance
 - Improves blood lipid profile
 - Improves blood pressure
- **Physical activity**
 - Supports weight loss
 - Improves blood glucose control
 - Improves blood lipid profile
 - Improves blood pressure

Osteoporosis

- Definition
 - “Porous bone”
- Risk factors
- Reducing the risk
 - Calcium and D
 - Weight-bearing exercise


Immune Function

- Immune system protects against infectious diseases
- Skin, mucous membranes, GI tract are first line of defense against foreign invaders
 - Bacteria, viruses, toxins, allergenic food proteins
- If penetrated, cells of the immune system take action against these antigens
 - Phagocytes
 - Secrete cytokines (direct immune, inflammatory responses)
 - Lymphocytes
 - B-cells (produce antibodies)
 - T-cells (attack antigens)




Nutrition and Immune Function

- **Malnutrition compromises immunity**
- Impaired immunity increases susceptibility to infectious disease
- Infectious diseases typically
 - Raise nutrient needs
 - Lower food intake
- Nutrition status suffers further
- Disease and malnutrition create a **synergistic downward spiral**
- Spiral must be broken for recovery to occur



Nutrition and Immune Function

- Who is likely to be caught in this spiral?
- People who restrict food intake
 - Due to lack of appetite
 - Eating disorders
 - Weight loss
- Very young or very old
- Poor
- Hospitalized
- Malnourished
 - Due to lack of food
 - Presence of disease – AIDS, cancer



Nutrition and Infectious Diseases

- Personal strategies to prevent infectious disease are important.
- Nutrition intervention can help prevent malnutrition and minimize the wasting that accompanies AIDS.
- There are new threats of the spread of disease-causing microorganisms due to bioterrorism.

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Nutrition and Infectious Diseases

- The Immune System
 - Organs of the immune system fight antigens
 - Spleen
 - Lymph nodes
 - Thymus
 - Phagocytes
 - Engulf and digest invaders; a process is called phagocytosis
 - Secrete special proteins called cytokines that activate a metabolic and immune response

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Nutrition and Infectious Diseases

- The Immune System
 - Lymphocytes: B-cells
 - Produce antibodies that react selectively, part of a class of proteins called immunoglobulins
 - Retain memory to react faster with the same foreign organism
 - Resistance to infection
 - Lymphocytes: T-cells
 - Release powerful chemicals to destroy foreign particles
 - Highly specific, attacking only one antigen
 - Defend against fungi, viruses, parasites, some bacteria, and cancer cells
 - Participate in the rejection of transplanted tissue

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Nutrition and Infectious Diseases

- Nutrition and Immunity
 - Malnutrition compromises immunity.
 - Immunity and infectious disease increase nutrient needs and lower food intake.
 - The synergistic downward cycle of disease and malnutrition must be broken for recovery to occur.
 - Opportunistic infections develop when the immune system is suppressed.

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Nutrition and Infectious Diseases

- HIV and AIDS
 - HIV (human immunodeficiency virus) is the infection that attacks the immune system and disables the body's defenses.
 - AIDS (acquired immune deficiency syndrome) is the infectious disease that destroys health and life.
 - Epidemic
 - Early detection and early intervention are critical.

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TABLE 18-2 HIV and AIDS Epidemic at a Glance, 2005

	World	United States
Living with HIV or AIDS	40,300,000	1,100,000
Newly infected with HIV	4,900,000	43,000
AIDS deaths	3,100,000	18,000

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Immune Function and Micronutrients

- Deficiencies diminish immune response
- Excess amounts may impair immunity
- Interactions between nutrients may enhance or impair immunity
- Optimal immunity depends on optimal nutrition
 - Enough, but not too much, of each nutrient

- Deficiencies (↓) and toxicities (↑) known to impair immunity
 - Protein (↓)
 - Energy (↓)
 - Vitamin A (↓)
 - Vitamin E (↓)
 - Vitamin D (↓)
 - B vitamins (↓)
 - Folate (↓)
 - Vitamin C (↓)
 - Iron (↓↑)
 - Zinc (↓↑)
 - Copper (↓)
 - Magnesium (↓)
 - Selenium (↓)

The diet strategies to which medicine is the cornerstone of immunity against disease.

Proper Nutrition Shields Against Diseases

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