

HSS2342; Nutritional Determinants of Health

Water Soluble Vitamins

The water-soluble Vitamins: B vitamins and Vitamin C

The Vitamins – An overview

- Bioavailability
 - o Quantity provided by food
 - o Amount absorbed and used by the body
 - o Factors influencing bioavailability
 - Efficiency of digestion
 - Nutrition statutes
 - Method of food preparation
 - Source of nutrient
 - Other foods consumed at same time
- Precursors
 - o Pro-vitamins
 - Converted to active form in the body
 - o Organic nature
 - Can be destroyed during storage and in cooking
- Solubility
 - o Affects absorption, transport, and excretion
 - o Water-soluble
 - Move directly into blood
 - Most travel freely
 - o Fat solution
 - Enter lymph and then blood
 - Require transported proteins
 - o Consumption frequency of vitamins

The B vitamins – As individuals

- Vitamins do not provide the body with fuel for energy
- Coenzymes
 - o Assist enzymes with release of energy
 - Without coenzymes, an enzyme cannot function

Thiamin

- Part of coenzyme thiamin pyrophosphate (TPP)
 - o Energy metabolism
 - Conversion of pyruvate to acetyl CoA
 - TCA cycle
 - o Nerve activity and muscle activity
- Recommendations – 1-2mg required per day
- Deficiency
 - o Malnourished and alcoholics
 - o Beriberi
 - Dry – nervous system
 - Wet – cardiovascular system
 - o Toxicity
 - No adverse effects – no UL
- damages the nervous system
- affects CVS by dilating vessels - heart has to pump harder to pump more blood. kidneys retain more water
- Food sources; pork/meat has sufficient
- Prolonged cooking destroys thiamin

- Leaches into water when boiling or blanching foods
- There are cooking methods that conserve thiamin

Riboflavin(B2)

- Serves as coenzyme in energy metabolism
 - o Flavin mononucleotide (FMN)
 - o Flavin adenine dinucleotide (FAD)
- Recommendations
- Deficiency= inflammation of membranes
- Toxicity – No UL
- gold in color - used as a coloring agent in energy drinks
- 1-1.25mg/day
- Stable to heat – not destroyed by cooking
- Liver and clams high in riboflavin

Niacin

- Two chemical structures
 - o Nicotinic acid
 - o Nicotinamide – major form of niacin in the blood
- Two coenzymes forms – metabolic reactions
 - o Nicotinamide adenine dinucleotide (NAD) – carries hydrogens and their electrons
 - o NADP (the phosphate form)
- Recommendations
 - o Body manufactures from tryptophan
 - Only occurs after protein synthesis needs have been met
 - o RDA is stated in niacin equivalents
 - o Deficiency – Pellagra – symptoms??
- only vitamin that can be synthesized in the body from Tryp
- recommendations RDA : 16NE per day
- Toxicity
 - o Naturally occurring – no harm
 - o Supplements or drugs – “niacin flush”
 - o Potential health benefits of large doses of nicotinic acid
- Food sources
 - o Less vulnerable to food preparation losses
- Leaches into cooking water

Biotin

- Coenzyme that carries activated carbon dioxide
 - o Critical in TCA cycle
 - Delivers carbon to pyruvate to form oxaloacetate
 - o Participates in gluconeogenesis and fatty acid synthesis
 - o Participates in breakdown of FA and AA
- No RDA or UL
- Deficiencies are rare – but can cause depression, lethargy, rash – disrupting energy metabolism pathway
- Food sources are widespread
- Recommendations – Adequate intake (AI)?
- Deficiencies – rare, symptoms?
- Toxicity – no UL?
- Food sources?
- Can be bound in protein in egg white – if excessive amount of eggs – may lead to a deficiency

Pantothenic Acid

- Part of chemical structure of coenzyme A
 - o Roles in the body – synthesis of lipids, neurotransmitters, hemoglobin
- Recommendation – AI = 5mg/day
- Deficiencies are rare

- Toxicity – No UL
- Food sources – availability is widespread

Vitamin B6

- Three forms
 - o Pyridoxal, pyridoxine, and pyridoxamine
 - o Conversion to coenzyme PLP
 - Amino acid metabolism
 - Urea metabolism
 - Conversion of tryptophan to niacin or serotonin
 - Synthesis of heme, nucleic acids and lecithin
- Stored exclusively in muscle tissue
- Recommendations – Large doses
 - o Large doses will help strengthen muscles and endurance
 - o Added to energy drinks
 - o RDA = 1.3mg/day
- Deficiency – Symptoms?
 - o Alcohol and isoniazid
- Toxicity
 - o Irreversible nerve degeneration
- Food sources

Folate

- Known as folacin or folic acid
- Primary coenzyme form – THF (tetrahydrofolate)
 - o Transfers single-carbon compounds during metabolism
 - Convert vitamin B12 to coenzyme form
 - Synthesize DNA
 - Regenerate methionine from homocysteine
- Folate disposal
 - o Secretion by liver into bile
 - Enterohepatic circulation
 - Vulnerable to GI tract injuries
- Recommendations
 - o Bioavailability of folate
 - Synthetic vs. food sources
 - o Increased need – when there is a multiplication of cells (ex; pregnancy)
- Deficiency = spina bifida in baby – due to neural tube defects
- Flour is enriched with folate
- Heart disease
 - o Breakdown of homocysteine
 - Blood clots and atherosclerotic lesions
 - o Risk of heart attacks, stroke, or death from cardiovascular causes
- Cancer
 - o Type of cancer
 - o Timing of supplementation
- Deficiency
 - o Impairs cell division and protein synthesis
 - o RBCs and GI tract cells falter
 - Anemia, GI tract deterioration
 - o Primary deficiencies, and secondary deficiencies (drugs)
- UL = 1000mg/day
- Bioavailability = ~50% from food

Vitamin B12

- Vitamin B12 and folate depend on each other for activation

- Regeneration of methionine , synthesis of DNA, and synthesis of RNA
- Individual roles of vitamin B12
- Digestion and absorption
 - Stomach
 - Small intestine – intrinsic factor
- Transported in blood by specific binding proteins
- Enterohepatic pathway
- Deficiency is rare
- Recommendations (RDA Adults : 2-4 micrograms/day)
- Deficiency
 - Inadequate absorption – lack of hydrochloric acid or intrinsic factor
 - Pernicious anemia
 - Vegan diets
 - Anemia of folate deficiency
 - Symptoms of vitamin B12 deficiency

Vitamin-Like Compounds

- Choline
 - Manufactured from methionine in the body
 - Conditionally essential nutrient
 - Adequate intake?
 - Common sources?
 - Deficiencies are rare
 - Roles in the body
 - Required for acetylcholine synthesis
- Inositol
 - Part of cell membrane structures
- Carnitine
 - Transports long chain fatty acids for oxidation
- Both can be made by the body
 - No recommendations established
- Both are widespread in foods

A healthy tongue as a rough and somewhat bumpy surface

In a B vitamin deficiency the tongue becomes smooth and swollen due to atrophy of the tissue (glossitis)

IN a B vitamin deficiency the corners of the mouth become irritated and inflamed (cheilosis)

The B vitamins – In Concert

- Toxicities
 - Excess eliminated through urine excretion
 - Homeostasis disruption – Toxicities develop
- Food sources
 - First choice should be foods rather than supplements

Vitamin C

- Roles
 - Antioxidant
 - Defends against free radicals – loses electrons easily
 - Vitamin C recycling
 - Protects from oxidative stress – disease prevention
 - Enhances iron absorption
 - Cofactor in collagen formation
 - Matrix for bone and tooth formation
 - Conversion of proline to hydroxyproline
 - Cofactor in other reactions
 - Hydroxylation of carnitine
 - Conversion of tryptophan to serotonin

- Conversion of tyrosine to norepinephrine
 - Making hormones
 - In stress
 - Adrenal glands release vitamin C and hormones into blood
 - Types of stress that increase vitamin C
 - Prevention and treatment of common cold
 - Conflicting and controversial research
 - Deactivates Histamine
 - Disease Prevention
- Recommendations
 - Prevent overt symptoms of scurvy
 - Absorption maximum – 200mg
 - Higher vitamin C levels are required for smokers
 - Notable signs of deficiency
 - Gums bleed easily around teeth
 - Capillaries under skin break spontaneously
 - Scurvy
 - Other physical signs
 - Psychological signs
 - Sudden death
- Toxicity
 - Supplementation side effects
 - Diarrhea
 - GI distress
 - UL ????
 - Interference with medical regimens
 - Medical conditions in which high doses of vitamin C should not be consumed

The Fat Solution Vitamins; A, D, E, and K

Vitamin A and Beta-Carotene

- Vitamin A, first fat-soluble vitamin recognized
 - Precursor = beta-carotene
- Three different forms – each has a specific role to play
 - Retinol, retinal and retinoic acid
 - Conversion to other forms
- Absorption and conversion
 - Beta-carotene
- Digestion and absorption of Vitamin A
 - Proteins participate in digestion and absorption
- Storage – Liver (~90%)
- Transport protein in liver - retinol-binding protein (RBP)
- Cellular receptors for vitamin A
- Roles in the body
 - Major roles
 - Vision
 - Protein synthesis and cell differentiation
 - Reproduction and growth
 - Regulation of gene expression
 - Retinol
 - Supports reproduction
 - Major transport and storage form
 - Retinal

- Active in vision
 - Retinoic acid acts as a hormone
 - Regulates cell differentiation, growth, and embryonic development
 - Vision
 - Cornea
 - Retina
 - Photosensitive cells
 - Rhodopsin
 - Repeated small losses of retinal
 - Need for replenishment
 - Protein synthesis and cell differentiation
 - Epithelial cells
 - Skin
 - Mucous membranes – Goblet cells
 - Reproduction and growth
 - Sperm development
 - Normal fetal development
 - Growth of children – bone remodeling
 - Antioxidant – Beta-carotene
- Vitamin A Deficiency
 - Vitamin A status
 - Adequacy of stores in the liver
 - Protein status
 - Consequences of deficiency
 - Risk of infectious disease
 - Blindness
 - Death
 - 90% stored in the liver
 - Too much can make skin look yellowish
 - Infectious disease
 - Measles severity
 - Malaria, lung disease, and HIV
 - Night blindness – inadequate supply of retinal to retina
 - Blindness (xerophthalmia)
 - Lack of vitamin A at the cornea
 - Develops in stages
 - Good mucous membranes – ensures better defence system
 - Keratinization of the cornea – xerophthalmia
 - Keratinization
 - Change in shape and size of epithelial cells
 - Skin becomes dry, rough, and scaly
 - Normal digestion and absorption of nutrients from GI tract falters
 - Weakened defenses in respiratory tract, vagina, inner ear, and urinary tract
- Vitamin A toxicity
 - Develops when binding proteins are swamped - free vitamin A damages cells
 - Toxicity is a real possibility
 - Performed vitamin A from animal sources
 - Fortified foods
 - Supplements
 - Children are most vulnerable

- Beta- Carotene
 - Found in many fruits and vegetables
 - Inefficient conversion (not 1 to 1)
 - Overconsumption from food = yellow skin
 - Overconsumption from supplements
 - Antioxidant becomes prooxidant
 - Alcohol consumption and tobacco use
- Bone defects
 - May weaken bones – Osteoporosis
 - Interferes with vitamin D
- Birth defects – cell death in the spinal cord
- Acne – vitamin A relative – Retin-A
- Recommendations
 - Expressed as retinol activity equivalents (RAE)
 - One microgram of retinol counts as 1 RAE
 - Supplements often measured in International Units (IU)

Vitamin D

- Not an essential nutrient
 - Body synthesizes
 - Sunlight
 - Precursor from cholesterol
- Activation of vitamin D
 - Two hydroxylation reactions
 - Liver and Kidneys
- Serum levels of 5-hydroxy vitamin D during blood tests
- Roles in the body
 - Active form of vitamin A is a hormone
 - Binding proteins carries it to target organs
 - Bone growth
 - Calcium and phosphorus absorption
 - Enhances absorption
 - Provides minerals from other sources
 - Other roles
 - Enhances or suppresses gene activity
- Deficiency
 - Overt signs are relatively rare
 - Insufficiency is quite common
 - Contributory factors
 - Dark skin, breastfeeding without supplementation, lack of sunlight, not using fortified milk
 - Creates a calcium deficiency
 - Rickets
 - Bones fail to calcify normally – bones bend
 - Affects children
 - Osteomalacia
 - Poor mineralization of bones
 - Affects adults
 - Bones are soft, flexible, brittle and deformed
 - Osteoporosis
 - Loss of calcium from bones – results in fractures
 - Elderly
 - Vitamin D deficiency is especially likely

- Lose ability to make and activate vitamin D
- Brink less milk
- Spend much of their day indoors
- Toxicity
 - Most likely of vitamins to have toxic effects
 - Raises blood calcium concentrations
 - Forms stones in soft tissues
 - May harden blood vessels – can cause death
- Recommendations and sources
 - Few food sources
 - Oily fish and egg yolks
 - Fortified milk
 - Sun exposure
 - No risk of toxicity
 - Skin color, latitude, season, and time of day
- 25-OH-D threshold
- UL = 400iu = 100mg

Vitamin E

- Four different tocopherol compounds
 - Alpha, beta, gamma and delta
 - Position of methyl group
 - Alpha tocopherol – vitamin E activity in the body
- Antioxidant
 - Stop chain reaction of free radicals
 - Protect cells and their membranes
 - Heart disease and protection of LDLs
- Deficiency
 - Primary deficiency is rare
 - Secondary deficiency – fat malabsorption
 - Effects of deficiency
 - RBC break open 0 Erythrocyte hemolysis
 - Neuromuscular dysfunction
 - Other conditions and vitamin E treatment
- Toxicity
 - Liver regulates Vitamin E concentrations
 - Toxicity is rare
 - UL is 65 times greater than recommended intake for adults
 - Extremely high dose of vitamin E – may interfere with vitamin K activity – Hemorrhage
- Recommendations and Foods
 - RDA is based on alpha-tocopherol only – RDA = 15mg/day
 - idespread in foods- destroyed by heat processing and oxidation

Vitamin K

- Can be obtained from non-food sources – Bacteria in the GI tract
- Acts primarily in blood clotting – Prothrombin
- Metabolism of bone proteins – Osteocalcin = low bone density
- Other possible roles of vitamin K in the body
- Deficiency
 - Primary deficiency is rare
 - Secondary deficiency
 - Fat absorption falters
 - Some drugs disrupt vitamin K's synthesis and action
 - Newborn infants

- Sterile intestinal tract
 - Single dose of vitamin K given at birth
- Toxicity
 - Not common – no adverse effects with high intakes
 - No UL
 - High doses can reduce effectiveness of anticoagulant drugs
- Sources
 - GI tract – half of a person’s needs, Stored in the liver
 - Food sources; green vegetables, vegetable oils

Fat-Soluble Vitamins – in summary

- Toxicities are possible
- Function of fat-soluble vitamins together
 - Vitamin E and A
 - Oxidation, absorption and storage
 - Vitamins A, D and K
 - Bone growth and remodeling
 - Vitamins E and K
 - Blood clotting

Health and Disease

Nutrition and Infectious Disease

- Nutrition cannot directly prevent or cure infectious diseases
 - Good nutrition can strengthen body’s defenses
 - Poor nutrition weakens the immune system

The immune system

- Body’s first line of defence
 - Skin, mucous membrane and GI tract
- Antigens
 - Examples
- Two types of WBCs
 - Phagocytes
 - Lymphocytes
- Phagocytes
 - Scavengers of the immune system
 - First to arrive at the scene of an invader
 - Phagocytosis – engulf and digest antigen
 - Secrete cytokines
- Lymphocytes – B-cells
 - Rapidly divide and produce antibodies
 - Travel through bloodstream to site of infection
 - Stick to surface of antigens
 - Make it easy for phagocytes to ingest
 - Antibodies react selectively
 - Retain a memory
- Lymphocytes – T cells
 - Travel directly to invasion site
 - Recognize antigens on surface of phagocyte cells
 - T0cells multiply in response
 - Release chemicals to destroy antigen
 - Signal to slow down immune response
 - Highly specific
 - Organ transplants

Nutrition and Immunity

- Immune system responds to subtle changes in nutrition status – synergistic downward spiral
- Protein energy malnutrition (PEM) – impaired immunity
- Vitamin and mineral deficiencies and excesses – Diminish immune response

Inflammation and Chronic Disease

- Immune system response to infection and injury
 - o Acute inflammation
 - Phagocytes engulf microbes
 - Release of oxidative products to kill microbes
 - Inflammation fights off infection and promotes recovery
 - o Chronic inflammation
 - Harmful

Nutrition and Chronic Disease

- Leading causes of death in the US- Relationship with diet
- Chronic disease
 - o Interrelationship among chronic disease
 - o Numerous disease associations with various nutrients
 - o Multiple risk factors for each chronic disease
 - Modifiable risk factors
 - Nonmodifiable risk factors

Cardiovascular Disease

- Major causes of death around the world
 - o Family history
 - o Lifestyle factors
 - o Coronary heart disease (CHD) is most common form
 - Usually caused by atherosclerosis
- Atherosclerosis development
 - o Accumulation of fatty streaks along inner arterial walls
 - Streaks enlarge and harden
 - Encasement of fibrous connective tissue
 - o Plaques stiffen arteries and narrow passages
 - Well-developed plaques by age 30
 - o Dietary factors
 - o Inflammation
 - Damage to cells lining the blood vessels elicits inflammatory response
 - Immune system sends in macrophages
 - LDL cholesterol becomes trapped and engulfed by macrophages
 - Macrophages swell; eventually become cells of plaque
 - Aneurysm
 - C-reactive protein (CRP)
 - Lipoprotein-associated phospholipase A(2) or LP-PLA(2)
 - o Plaques
 - o Plaque stability – rupture
 - o Blood clots
 - Platelets and other factors from blood clots
 - Prostaglandins and thromboxanes
 - Omega-3 fatty acids
 - o Blood pressure
 - Plaques increase pressure
 - Atherosclerosis is a self-accelerating process
 - o The results
 - Heart attack
 - Transient ischemic attack (TIA)

| TABLE 18-4 Risk Factors for CHD | |
|--|--|
| Major Risk Factors for CHD (not modifiable) | |
| • | Increasing age |
| • | Male gender |
| • | Family history of premature heart disease |
| Major Risk Factors for CHD (modifiable) | |
| • | High blood LDL cholesterol |
| • | Low blood HDL cholesterol |
| • | High blood pressure (hypertension) |
| • | Diabetes |
| • | Obesity (especially abdominal obesity) |
| • | Physical inactivity |
| • | Cigarette smoking |
| • | An "atherogenic" diet (high in saturated fats and low in vegetables, fruits, and whole grains) |
| NOTE: Risk factors highlighted in yellow have relationships with diet. | |
| SOURCE: Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). <i>Third Report of the National Cholesterol Education Program (NCEP)</i> . NIH publication no. 02-5215 (Bethesda, MD: National Heart, Lung, and Blood Institute, 2002), pp. II-15–II-20. | |

Risk factors for coronary heart disease (CHD)

- By middle age, most adults have at least one risk factor
- Regular screening and early detection
- Standards for CHD risk factors
- High blood pressure (hypertension)
 - o Relationship with heart disease risk holds true for men, women, young and old
 - o Injures artery walls
 - o Accelerate plaque formation
- Diabetes
 - o Increases risk of death from CHD
- Obesity and physical inactivity
 - o Increase risk of CHD
 - High LDL, low HDL, hypertension and diabetes
- Cigarette smoking
 - o Smoking damages the heart directly
 - o Toxins in cigarette smoke damages vessels
- Atherogenic diet
 - o Elevates LDL cholesterol
- Other risk factors
 - o Elevated triglycerides
 - VLDL
 - Measurement of triglycerides
- Metabolic syndrome
 - o Cluster of health risks
 - o Markers of inflammation and thrombosis

Recommendations for reducing CHD risks

- Screening
 - o Cholesterol screening
 - Total cholesterol, LDL, HDL, triglycerides
 - Two measurements at least 1 week apart
- Intervention
 - o Lifestyle changes
 - Physical activity, dietary changes, lose weight, reduce exposure to cigarette smoke
 - o Medications

Hypertension

- Systolic and diastolic pressure with risk of death from CVD
- Physiological factors of hypertension
 - o Cardiac output
 - Heart rate or blood volume increases
 - o Peripheral resistance
 - Diameters of arterioles
 - o Regulated by nervous system and hormones
 - Kidneys
- Risk factors
 - o Aging, genetics, obesity, salt sensitivity, alcohol
- Treatment
 - o Weight control, physical activity, DASH diet (Lowers LDL and total cholesterol), salt/sodium intake, Drug therapy

Diabetes Mellitus

- Incidence has risen dramatically
 - o Prediabetes
- Sixth among leading causes of death
- Underlies or contributes to several other major disease

- Heart disease is leading cause of diabetes-related deaths
- Diabetes development
 - Characteristics
 - High blood glucose concentrations
 - Disordered insulin metabolism
 - Two main types
 - Type 1 and type 2
- Type 1 diabetes
 - Less common type – autoimmune disorder
 - Pancreas loses ability to synthesize insulin
 - Commonly occurs in childhood and adolescence
 - Energy metabolism changes – may threaten survival
 - Need insulin injections or external pump
- Type 2 diabetes
 - Most prevalent form of diabetes
 - Exact cause is unknown
 - Risk factors
 - Insulin resistance
 - Hyperinsulinemia
 - Amount of insulin is insufficient to compensate for diminished effect in cells
 - Chronic inflammation
- Complications
 - Acute
 - Chronic
 - Conversions of glucose to sugar alcohols
 - Loss of circulation and nerve function
 - Infections
 - Diseases of large blood vessels
 - Disease of small blood vessels
 - Disease of the nerves
- Recommendations for diabetes
 - Total carbohydrate intake
 - Carbohydrate sources
 - Fiber and sugar
 - Glycemic index
 - Dietary fat
 - Protein – kidney function
 - Alcohol – moderation
 - Type 1 diabetes
 - Adjust insulin to accommodate meals, physical activity, and health status
 - Nutrition therapy
 - Type 2 diabetes
 - Diet and regular moderate physical activity

Phytochemical

- Found in plant-derived foods – have biological activity in the body
- Physiological effects
 - Suppression of diseases
 - Adverse effects if consumed in excess
- Can act as antioxidants and mimic certain hormones
- Defending against cancer
 - Protect against DNA damage

- Soybeans – phytoestrogens
- Tomatoes – lycopene
- Defending against heart disease
 - Flavonoids
 - Food sources
 - Heart protection factors
 - Carotenoids
 - Phytosterols
 - Lignans

Functional Foods

- All foods that have a potentially beneficial effect on health
 - Whole, fortified, Modified
- Characteristics similar to food and drugs
- Consumption patterns for beneficial effect
- Cost
- Research for safety and effectiveness is still in progress

Isoflavone – soy phytoestrogens

- Phytoestrogens are estrogenic compounds found in plants
- Isoflavones are major soy phytoestrogens.
- Soybeans and soy food: 1.0-4.2mg/g
- Supplements: up to 500mg/g

Soy isoflavones: Breast Cancer

- Case control studies in Chinese and Asian Americans found that high soy intake in adolescence was associated with low risk for breast cancer in adulthood
- Clinical studies: soy isoflavones stimulate epithelial cell proliferation in breast of premenopausal women, a potential precursor
- Research remains insufficient that soy isoflavones are protective or harmful for breast cancer
- The efficacy and safety of soy isoflavones for preventing or treating breast cancer are not established

Soy Isoflavones: Prostate Cancer

- Prevent the development and growth of prostate cancer cells in animal models
- In prostate cancer cells, genistein reduced the synthesis of prostate-specific antigen (PSA)
- Did not reduce either PSA or serum testosterone levels in men with early-stage prostate cancer or in healthy middle aged men
- The efficacy and safety of soy isoflavones for preventing or treating prostate cancer are not established

Possible Factors Causing the Controversies

- Sources of soy proteins used in clinical studies
- Unidentified bioactive component(s)
- Bioactive compounds may have been removed or damaged during processing
- Composition of traditional Asian soy foods may be different from those consumed in Western countries
- Different sensitivities of subjects to soy

Nutrient Content Claims

- These claims can be used for any food that contains sufficient levels of a vitamin(s) or mineral(s) to meet the conditions for the claim
 - Good source of a specific nutrient
 - If the total amount of the nutrient in the food is 10% or more of the Daily Value (the amount would be labelled on a Nutrition Facts panel), that food would qualify for a “good source” claim
 - Excellent source of a specific nutrient
 - If the total amount of the nutrient in the food is 20% of the Daily Value then the food would qualify for an “excellent source” claim

Food Fortification and Health Canada’s Mandate

- Food and Drugs Act is a consumer protection statute intended to protect the consumer from health hazard and fraud related to the sale of food

- Food fortification (addition of vitamins and minerals to foods) is a mean to maintain and improve the nutritional quality of food supply

Current Regulatory Framework

- Regulations are perspective
 - o Addition not permitted unless listed in the Regulations
 - o Foods, nutrients and levels are specified
 - o In most cases, each category of food is subject to individual regulations which set levels
- Amendments are guided by Codex General Principles for the addition of Essential Nutrients to Foods

Food Fortification – Considerations

- Risk Category A nutrients
 - o Those vitamins and mineral nutrients for which no UL was set because of not reports of adverse effects, and no concern expressed
 - o Those nutrients for which a UL was set but with a wide margin of safe intake
 - o Those nutrients with a narrow margin of safety, but non-serious critical adverse effects: thiamin, riboflavin, pantothenate, biotin, vitamin B12, B-carotene, vitamin C, vitamin B6, Vitamin E, niacin
- Risk Category B nutrients
 - o Those nutrients with serious adverse effects, but with low risk of excessive intake at the proposed level of addition for discretionary fortification: calcium, folic acid, magnesium, vitamin D, potassium
- Risk Category c nutrients (to be excluded from discretionary fortification)
 - o Those nutrients with a narrow margin of safety, and with serious adverse effects, and/or with current levels of exposure to intakes above the UL by vulnerable subgroups: vitamin A as retinol, zinc, iron, copper, selenium, manganese, iodine, fluoride
 - o Nutrients in this category are currently permitted or required to be added to a range of foods for purposes of restoration, mandatory fortification, nutritional equivalence of substitute foods or to make a special purpose food such as a meal replacement . New or further additions for these purposes would continue to be subject to regulatory requirements
- Other nutrients
 - o For which a risk category has not been assigned include choline, chromium, molybdenum, phosphorus, vitamin K
 - o These nutrients are proposed to be excluded from discretionary fortification for a variety of reasons

Food and Drug act

- “drug” includes any substance or mixture of substances manufactured, sold or represented for use in
 - o The diagnosis, treatment, mitigation or prevention of a disease, disorder or abnormal physical state, or tis symptoms, in human beings or animals
 - o Restoring, correcting or modifying organic functions in human beings or animals, or
 - o Disinfection in premises in which food is manufactured, prepared or kept
- “food” includes any article manufactured, sold or represented for use as food or drink for human beings, chewing gum, and any ingredient that may be mixed with food for any purpose whatever

Food Allergies

- A food allergy is a food sensitivity cause by a reaction of the body’s immune system to specific proteins in food
- Current estimates are that food allergies affect as many as 6% of children and between 3 to 4% of adults
- IN allergic individuals, a food protein is mistakenly identified by the immune system as being harmful. The first time the individual is exposed to such a protein, the body’s immune system responds by creating antibodies called immunoglobulin E (IgE). When the individual is exposed again to the same food protein, IgE antibodies and chemicals such as histamine are released
- In the most extreme cases, food allergies can be fatal
- Although any food can provoke an immune response in allergic individuals, a few foods are responsible for the majority of food allergies

- Representatives from Health Canada, the Canadian Food Inspection Agency (CFIA), allergy associations and the medical community have identified nine substances most frequently associated with food allergies and allergic-type reactions. These substances are often referred to as the ten priority food allergens
- The ten priority food allergens are:
 - o Peanuts
 - o Tree nuts (almonds, Brazil nuts, cashew, hazelnuts, macadamia nuts, pecans, pine nuts, pistachios, walnuts)
 - o Milk
 - o Eggs
 - o Fish, crustaceans, shellfish
 - o Sesame seeds
 - o Soy
 - o Wheat and triticale
 - o Sulphites (although sulphites do not cause a true allergic reaction, sulphite-sensitive people may experience similar reactions as those with food allergies)
 - o Mustard

Food Intolerances

- A food intolerance is a food sensitivity that does not involve the individual's immune system
- Unlike food allergies, where a small amount of food can cause a reaction, it generally takes a more normal sized portion to produce symptoms of food intolerance
- While the symptoms of food intolerance vary and can be mistaken for those of a food allergy, food intolerances are more likely to originate in the gastrointestinal system and are usually caused by an inability to digest or absorb certain foods, or components of those foods

Celiac Disease

- Celiac disease is a common inherited autoimmune disease that affects nearly 1% of the population. It is caused by a permanent intolerance to "gluten", the collective name given to certain proteins in wheat, barley, rye, and triticale
- Symptoms of celiac disease vary greatly in number and severity from one person to another
- Currently the only treatment for celiac disease is to continually maintain a strict gluten-free diet

Impact of Food Allergies and Intolerance

- In Canada, food allergies and intolerances account for:
 - o A large number of emergency room and medical visits
 - o Several deaths each year, due to food anaphylaxis
 - o Food allergies and intolerances also have an impact on the families of individuals living with food allergies or intolerances, on school and/or daycare policies, social activities

Health Canada's Food Allergen Program

- Health Canada's Food Allergen Program is a pioneering Food Safety initiative that was developed in the early 1990's in support of the changing Canadian regulatory Environment. Its main objectives are:
 - o To minimize risks associated with inadvertent consumption of undeclared allergens in foods
 - o To maximize choices of safe and nutritious foods available to food allergic consumers
- Program elements
 - o Prevention of adverse reactions (through active education, regulatory guidance (review of policy on allergen-free claims, precautionary statements)...,etc...)
 - o Targeted oversight (preventive measures, such as proposed regulatory amendments to current food allergens labelling regulations...)
 - o Rapid response (risk assessment in support of recalls, improved detection methodologies...)

Prevention of adverse reactions

- Education
 - o Health Canada works and communicates with the general public and consumer groups to make them more aware of allergen-related issues. Activities include
 - Participation in major food allergy events
 - Support events organized by consumer groups

- Development of GoC pamphlets on priority allergens
 - Training on safe allergen handling practise to food industry, in collaboration with CFIA
- Precautionary statements background:
 - HC is currently reviewing its policy on the use of precautionary statements (may contain, etc...) on food labels used by industry to identify priority allergens that may have been unintentionally introduced into food during manufacturing
- Consumers are becoming increasingly confused by the variety of precautionary statements currently being used on pre-packaged foods
- Precautionary statements (may contain, etc...) used on food labels are a valuable risk management tool in situations where the presence of allergen is unavoidable
- Precautionary Statements Objective
 - To better protect Canadians and to maximize choices of safe and nutritious foods available to food allergic consumers, HC has determined that it is necessary to review the current policy on precautionary labelling in order to:
 - Restore the effectiveness of precautionary statements as a risk management tool
 - Mitigate the overuse/ misuse of precautionary statements; and
 - Better understand consumer perceptions vis-à-vis precautionary labelling

Targeted Oversight

- Regulatory amendments – Allergen Labelling New regulation published in CG2 in February 16 2011 with an 18 month transition period
- Background
 - The food and Drug Regulations require that a complete and accurate list of ingredient appear on the label of pre-packaged foods
- In most cases, the list of ingredients must include the components of ingredient, but current regulations exempt certain ingredients from component declaration
- There are currently no requirements for clear identification of the “source” of the allergenic ingredient (caseinate = milk, ovalbulmin – egg, etc...)
- Regulatory Amendments – Allergen Labelling:
- Objectives
 - To assists food allergic consumers and those with celiac disease in making informed food choices
 - Ensure the declaration of sources when the “protein fraction” of the allergen is deliberately added to the food;
 - Ensure that priority allergens are declared using their English/French common name;
 - Ensure that exemptions on declaration of ingredients of ingredients are lifted
 - Ensure the declaration of gluten sources

Rapid Response

- The Allergen Method Development Program:
 - Provides a unique repository of biological material specific to allergen markers
 - State of the art proteomics unit for allergen method development
- The harmonization of tools to detect and determine “hidden’ allergen markers in food (international leadership)

Pregnancy and Lactation

Nutrition Prior to Pregnancy

- Nutrition may affect fertility
- Preparation before pregnancy
 - Achieve and maintain healthy body weight
 - Choose an adequate and balanced diet
 - Be physically active
 - Receive regular medical care
 - Manage chronic conditions

- Avoid harmful influences
- The Placenta and Associated structure

Neural Tube Development

- At 4 weeks, the neural tube has yet to close
- At 6 weeks, the neural tube has successfully closed

Spina Bifida

Growth and Development During pregnancy

- Chronic disease
 - Adverse influences at critical times during fetal development
 - Malnutrition –type 2 diabetes
 - Inadequate growth during placental and gestational development – hypertension
- Fetal programming
 - Mother’s nutrition may change gene expression in the fetus

Maternal Weight

- Birthweight is most reliable indicator of infant’s health
- Weight prior to conception
 - Influences fetal growth
 - Underweight
 - Rates of preterm births and infant deaths
 - Overweight and obesity
 - Medical complications
 - Risks for infant
- Weight gain during pregnancy
 - Fetal growth and maternal health
 - Correlates closely with infant birth weight
 - Predictor of health and development
 - Recommended weight gains
 - Number of fetuses
 - Beginning weight
- Weight gain patterns
 - 3.5 pounds in first trimester
 - 1 pound per week thereafter
 - Large weight gain over short time
 - Preeclampsia
- Components of weight gain
 - Placenta, uterus, blood, breasts, fluid volume, baby
 - Maternal fat stores
- Weight loss after pregnancy
 - Return to pre-pregnancy weight – not typical
 - Retain a couple of pounds with each pregnancy
 - Seven or more pounds; BMI increase 1 unit
 - Diabetes and hypertension
 - Chronic diseases later in life

Exercise during Pregnancy

- Can continue exercise throughout pregnancy – adjust duration and intensity
- Benefits
- “Low-impact” activities
- Fetal development
 - Excessively high internal body temperature
 - Dehydration

Energy and nutrient needs during pregnancy

- Needs tend to be higher than any other time in life
- To meet needs
 - o Make careful selections
 - o Body maximizes absorption
 - o Body minimizes losses
- Energy
 - o Increase in basal metabolic rate
 - Second and third trimester
 - o Food energy
 - 15-20% more energy than before pregnancy
 - Nutrient dense foods
- Carbohydrate
 - o Maple carbohydrate is necessary
- Protein
 - o RDA – additional 25 grams per day
 - Supplements re discouraged
- Essential fatty acids
 - o Omega 3 and omega 6 fatty acids for brain material
- Blood production and cell growth
 - o Fetal growth and development
 - o Maternal red blood cell mass
 - o Needs for synthesis of DNA and new cells
 - Folate, vitamin B12, iron, zinc
- Nutrients for bone development
 - o Vitamin D – deficiency interferes with calcium metabolism
 - o Calcium
 - Absorption and retention increase
 - Intake usually falls below recommendations
 - o Other nutrients
 - Optimal interval between pregnancies

Vegetarian Diets During Pregnancy and Lactation

- Can support healthy pregnancy and lactation
 - o Well planned
 - o Food sources
- Vegan diets
 - o Additional supplementation
 - o Risks

Lactation: A physiological Process

- Hormones promote growth and branching of duct system and milk-producing cells
 - o Prolactin – milk production
 - o Oxytocin – cause mammary glands to eject milk into ducts

Breastfeeding: A learned Behaviour

- Lactation is an automatic, physiological process
- Breastfeeding is a learned behaviour
 - o Some decide not to breastfeed
- Factors influencing breastfeeding and its success
 - o Partner
 - o Adequate nutrition and rest

Maternal Energy and Nutrient Needs During Lactation

- Energy intake and exercise
 - o Almost 500 extra kcalories per day
 - o Exercise is compatible with breastfeeding

- Energy nutrients
 - o Recommendations increase for carbohydrates and fibers
- Water – prevent dehydration
- Vitamins and minerals
 - o Inadequacies reduce the quantity, not quality of breast milk
 - Quality maintained at expense of maternal stores
 - o Prolonged inadequate intakes
 - Impacts several nutrients
 - o Supplements – iron

Maternal Health

- HIV infection and AIDS
 - o Transmission through breastmilk – Medications
- Diabetes – type 1
- Postpartum amenorrhea – does not protect from pregnancy
- Breast health - breast cancer

Practices incompatible with lactation

- Alcohol
 - o Easily enters breast milk
 - o Infants eat less when mother consumes alcohol
- Medical drugs – physician consultation
- Illicit drugs – risks
- Smoking
 - o Reduces milk volume
 - o Less sleep
 - o Passive smoking and SIDS
- Environmental contaminants
 - o DDT, PCBs, and dioxin
- Caffeine
 - o Iron bioavailability

Fetal Alcohol Syndrome

- Alcohol readily crosses the BPB
 - o Deprives fetus of nutrients and oxygen
- Fetal Alcohol spectrum disorder
 - o Fetal alcohol syndrome (FAS)
 - Cluster of physical, mental, and neurobehavioral symptoms
 - o Alcohol-related neurodevelopmental disorder (ARND)
 - o Alcohol-related birth defects (ARBD)
- Abstinence from alcohol during pregnancy is recommended
 - o Severe consequences
 - o FAS can only be prevented – not treated
- Abstinence is recommended for those who may become pregnant
- Typical Facial Characteristics of FAS
 - o Head – small head size
 - o Forehead – narrow, receding forehead
 - o Jaw – underdeveloped jaw, receding chin, receding or flattened upper jaw
 - o Eyes – extra skin folds on eyelids, drooping eyelids, downward slant of eyes, usually small eyes and/or eye openings, short sightedness, inability to focus (“wandering eyes”)
 - o Ears – uneven in placement and size, poorly formed outer ear, backward curve
 - o Lips – absence of groove in upper lip, flat upper lip, thin upper lip

Drinking during Pregnancy

- Direct damage – intoxication
- Indirect damage – malnutrition
- Alcohol interferes with tissue development during critical periods

- Fetal blood alcohol concentration (BAC_ increase until even with maternal BAC levels)

Canada's Food Guide

- It translates the science of nutrition and health into a healthy eating pattern
- It emphasizes the importance of combining healthy eating and physical activity

Life Cycle Nutrition: infancy, Childhood, and Adolescence

Nutrition during infancy

- Infant growth during first year
 - o Reflects nutrient intake
 - o Birthweight changes
 - o Infant's length
- Energy requirement
 - o Twice that of an adult
- Energy nutrients
 - o First six months vs. second six months
 - o Carbohydrates
 - Brain side (~12% of bw vs ~2% in adult)
 - o Fat
 - o Protein
 - Basic building material of body's tissues
 - Protein overload
- Vitamins and mineral s
 - o Needs are greater than adults
- Water
 - o Percentage of body weight as water
 - o Dehydration

Breast milk

- Practive of breastfeeding
 - o Length of exclusive breastfeeding
 - Introduction of complementary foods
 - o Frequency and duration of feedings
 - o Energy nutreitns
 - Lactorse, oligosaccharides
 - Essential fatty acids
 - Protein (alpha-lactalbumin)
- Percentages of Energy yielding Nutrients in Breast Milked and in recommended Adul2ts diets
- Proactive of breastfeeding
 - o Vitamins and minerals
 - Vitamin D
 - Supplements
 - o Immunological protection
 - Colostrum
 - Bifidus factors (lactobacillus bifidus)
 - Other protective factors
- Allergy and disease protection
 - o Lower incidence of allergic reactions
 - o Protection against development of cardiovascular disease
 - Blood pressure
 - Blood cholesterol
 - o Protection against excessive weight gain

- Intelligence – controversial

Infant formula

- Composition
 - Attempt to copy composition of breast milk
 - Iron-fortified
- No protective antibodies
- Safe preparations
- Risk of lead poisoning
- Infant formula standards
 - From well-nourished mothers during first or second month of lactation
- Special formulas
- Inappropriate formulas – Goat's milk
- Nursing bottle tooth decay

Special needs of preterm infants

- Preterm or premature
 - Incomplete fetal development
 - Leading cause of infant deaths
 - Often low-birthweight infants
 - Benefits of third trimester for infant
 - Breast milk
 - Supplements

Introducing Cow's Milk

- Not advised before age 1
- Children 1 to 2 years of age
 - Types of milk to avoid
- Children aged 2 to 5
 - Gradual transition from whole to lower-fat milks

Introducing Solid Foods

- When to begin
 - Between 4 and 6 months
 - Developmental capability
 - Purpose of solid foods
- Food allergies
 - Single ingredient foods
 - One at a time in small portions
 - Waiting period
- Choice of infant foods
 - Provide variety, balance and moderation
 - Commercially prepared vs homemade foods
- Food labels
 - No fat information for children younger than two
 - Need for fat due to growth rate
- Foods to provide iron
 - Breast milk or iron-fortified formula
 - Iron fortified cereals
 - Meat and meat alternatives
- Foods to provide vitamin C – fruits and vegetables
- Foods to omit – honey and corn syrup
- Vegetarian diets
 - Newborn is lacto-vegetarian
 - Beyond six months

- Vegan diets –growth and development
 - Well-balanced vegetarian diet
- Foods at 1 year
 - Cow's milk
 - Displacement of iron-rich food sources

Mealtime with Toddlers

- Feeding guidelines
 - Discourage unacceptable behaviour
 - Let toddler explore and enjoy foods
 - Don't force food on children
 - Provide nutritious foods
 - Let child choose which ones and how much
 - Limit sweets
 - Don't turn dining table into battleground

Nutrition during childhood

- Annual growth
 - Height (2-3 inches)
 - Weight (5-6 pounds)
- Abilities change as children age
- Body composition and shape changes

Energy and Nutrient Needs in Childhood

- Carbohydrate and fiber
 - Recommendations are the same for children and adults
 - Fiber recommendations
- Fat and fatty acids
 - DRI committee recommendations
 - 30-40 % for 1 to 3 year olds
 - 25 -35% for 4 to 18 year olds
- Protein recommendations
 - Considerations
 - Nitrogen balance
 - Quality of protein
 - Added needs for growth
- Vitamins and minerals
 - Needs increase with age
 - Iron and vitamin D
 - Supplements

Hunger and Malnutrition in Children

- Very low income families
 - Greater risk of hunger and malnutrition
- Meal skipping and academic performance
 - Benefits of breakfast consumption
- Iron-deficiency and behaviour
 - Behaviour, attention span, and learning ability
 - Testing for iron status
 - Effects of deficiency occur before blood effects occur

The Malnutrition-Lead Connection

- Malnourished children are vulnerable to lead toxicity
- Low intakes of certain nutrients increases risk of lead toxicity
 - Calcium, zinc vitamins C and D, and iron
- Commonalities between iron deficiency and lead toxicity
- Effects of lead toxicity

- Lead accumulation in the body
 - o Bones, brain, teeth, and kidneys
- Federal laws have reduced lead exposure
 - o Lead exposure is still a threat

Hyperactivity and “Hyper” behaviour

- Hyperactivity
 - o Characteristics
 - o Cause is unknown
 - Sugar, food additives
 - o Symptoms tend to improve as child gets older
- Misbehaving

Food Allergy and Intolerance

- Prevalence of true food allergies in children
 - o Tend to diminish with age
- True food allergy
 - o Immunologic response to food
 - o Reaction may be immediate or delayed
- Detecting food allergies
 - o Testing for antibodies
 - o Treatment

Childhood Obesity

- Number of overweight children has dramatically increased
 - o Overweight defined
 - Above 85th percentile
 - o Obesity defined
 - Above 95th percentile
 - o Severe obesity defined
 - Above 99th percentile

Nutrition during Adolescence

- Growth and development
 - o Adolescent growth spurt
 - Timing of males vs. females
 - Height changes
 - Weight changes
 - o Difference between genders become apparent
- Energy and nutrition needs
 - o Vitamins
 - RDAs or AIs for most vitamins increase
 - Vitamin D deficiencies
 - o Iron
 - Boys vs girls
 - Growth spurt
 - o Calcium
 - Peak bone mass

Energy and Nutrient Needs in Childhood

- Appetites diminish around 1 year of age
 - o Food intakes coincide with growth patterns
- Energy intakes vary from meal to meal
 - o Energy needs vary widely
 - Growth and physical activity
 - Difficulty meeting energy needs

Nutrition during adolescence

- Energy and nutrient needs

- Needs are great
- Needs vary greatly
 - Factors influencing energy needs
 - Boys vs. girls
- Obesity during adolescence
- Food choices and health habits
 - Benefits of eating meals with family
 - Skipping breakfast
 - Eating fast food
 - Parental gatekeepers
 - Controlling type and availability of food
 - Snacks
 - 1/4th of average teenager's daily food intake
 - Beverages
 - Soft drink consumption – caffeine and milk displacement
 - Eating away from home
 - Peer influence
 - Choices often reflect opinions and actions of peers
 - Drug abuse
 - Alcohol abuse
 - Smoking
 - Influences hunger, body weight, and nutrient status
 - Smokeless tobacco
 - Health problems
 - Other drawbacks

Life Cycle Nutrition: Adulthood and the Later Years

Introduction

- Two motivating goals
 - Promote health
 - Slow aging
- The ratio of old people to young is increasing
 - Growing "old" happens day by day
 - Fastest growing age group
- Factors influencing life expectancy

Nutrition and Longevity

- Diversity of older adults
- Nutritional influence on aging process
 - Aging is inevitable
 - Process can be slowed by adopting healthy lifestyle

Observation of older Adults

- Healthy habits
 - Physiological age vs. chronological age
 - Lifestyle behaviours
 - Eating well-balanced meals
 - Engaging in physical activity
 - Not smoking
 - Abstinence or moderate use of alcohol
 - Maintaining a healthy body weight
 - Sleeping regularly and adequately
- Physical activity

- Benefits of physical activity in older adults
- Additional benefits
 - Aerobic activities
 - Moderate endurance activities
 - Strength training
 - Resistance training
- Most powerful predictor of mobility in later years

Manipulation of Diet

- Energy restriction in animals
 - Animals live longer and have fewer age-related diseases
 - Slows aging process
 - Food intake
 - Prevent malnutrition
 - 70% of normal energy intake
 - Increases antioxidant activity and DNA repair
 - Age of starting energy restriction
- Energy restriction in human beings
 - How to define energy restriction
 - Time of energy restriction needed to realize health benefit
 - Moderate restriction
 - 10 to 20 percent reduction in erg intake
 - Benefits
 - Nutritional adequacy is essential to a long and healthy life

The Aging Process

- Stress
 - Psychological and physical stressors
 - Bodily response
 - Nervous and hormonal systems
 - Prolonged or severe stress effects
 - Men vs women
 - Fight or flight response
 - Tend or befriend response
- Physiological changes
 - Body weight
 - Being moderately overweight may not be harmful
 - BMI of at least 27
 - Obesity complications
 - Risks associated with low body weight
 - Body composition
 - Changes
 - Sarcopenia
 - Optimal nutrition, sufficient protein, and regular physical activity
 - Immunity and inflammation
 - Immune system loses function
 - “inflammaging”
 - Inflammation – critical in supporting health
 - Compromised by nutrient deficiencies
 - Antibiotics often are not effective against infections
 - Regular physical activity improves immune system responses
 - GI tract
 - Intestinal walls lose strength and elasticity
 - Slowing of motility
 - Diminished appetite

- Trophic gastritis
 - Dysphagia
 - Tooth loss
 - Difficult and painful chewing
 - Limited food selections
 - Less dietary variety
 - Lower intakes of fiber and vitamins
 - Sensory losses and other physical problems
 - Vision, mobility, hearing, taste, and smell
 - Depression
 - Lose appetite and motivation to cook
- Economic changes
 - Living arrangements and income
- Social changes
 - Hospital and nursing home malnutrition
 - Community malnutrition

Energy and Nutrient needs of Older Adults

- Dietary reference intakes (DRI)
 - Two age categories
 - 51 to 70 years
 - 71 and older
- Challenges with setting standards
- Individual differences are more pronounced with age
- Different chronic diseases
- Different medications
- Vitamins and minerals
 - Vitamin B12
 - Fortified foods and supplements
 - Vitamin D
 - Folate
 - Calcium
 - Iron
 - Zinc

Nutrition-related Concerns of Older Adults

- Vision
 - Cataracts
 - Age related clouding of the lenses of the eyes
 - Lead to blindness if not surgically removed
 - Risk factors
 - Oxidative stress and antioxidants
 - Macular degeneration
 - Leading cause of vision loss
- Arthritis
 - Osteoarthritis
 - Deterioration of cartilage in the joints
 - Connection with being overweight
 - Benefits of aerobic activity and strength training
 - Gout
 - Deposits of uric acid in joints
 - Purines in foods
 - Rheumatoid arthritis
 - Autoimmune disorder
 - Omega-3 fatty acids

- Heart-healthy diet
 - Treatment
 - Dietary and traditional medical intervention
 - Popular supplements
- The aging brain
 - Alzheimer's disease
 - Prevalence in US
 - Characteristic symptoms
 - Possible causes
 - Senile plaques and neurofibrillary tangles
 - Cardiovascular disease risk factors
 - Treatment

The interactions between Drugs and nutrients

- Interactions can
 - Lead to nutrient imbalances
 - Interfere with drug effectiveness
- Factors that increase risk for adverse nutrient drug interactions
- Methods of nutrient and medication interactions
- Drugs alter food intake
 - Eating may be difficult or unpleasant
 - May stimulate appetite and cause weight gain
 - May suppress appetite and promote weight loss
- Drugs alter nutrient absorption
 - Most likely occurs with medications that damage the intestinal mucosa
 - May bind with nutrient in GI tract, preventing nutrient absorption
 - May reduce stomach acidity
 - May interfere with intestinal metabolism or transport of nutrients into mucosal cells
- Diets alter drug absorption
 - Most drugs are absorbed in upper small intestine
 - Influences on drug absorption
 - Stomach acidity and emptying rate
 - Direct interactions with dietary components
 - Drug formulation
 - Binding with nutrients and non-nutrients
- Drugs alter nutrient metabolism
 - Some drugs may enhance or inhibit activities of enzymes needed for nutrient metabolism
- Diet alters drug metabolism
 - Some foods affect the activities of enzymes that metabolize drugs
 - May counteract the drugs' effects
 - Some food and drug interactions can cause toxicity and exacerbate side effects
- Drugs alter nutrient excretion
 - Interfere with nutrient reabsorption
 - Mineral depletion
- Diets alter drug excretion
 - May lead to toxicity
 - Urine acidity

Hunger and the Global Environment

Introduction

- Worldwide, one person in every seven experiences persistent hunger
 - o One child every five second dies from hunger related causes
- Hunger is linked with
 - o Poverty
 - o Population growth
 - o Environmental degradation

Hunger in the United States

- Food insecurity
 - o Limited or uncertain availability of nutritionally adequate and safe foods
- Consequences of inadequate diets
 - o Poor health
 - o Impaired physical, psychological and cognitive development in children

Prevalence of food Security and Insecurity in US households

Defining Hunger

- Hunger
 - o No food
 - o Too little food – food insufficiency
 - Eat small meals
 - Skip meals
- Causes of food poverty
 - o Primary cause of poverty
 - o Other threats to financial stability
- Other contributors to food poverty
 - o Alcohol or drug abuse
 - o Lack of resources
 - o Lack of awareness of assistance programs
 - o Reluctance to accept help
- Hunger and obesity exist side by side
 - o Highest obesity rates occur among those living in greatest poverty
 - Providing food actually prevents obesity
 - o Poor quality diets deliver more kcalories and fewer nutrients for less money

World Hunger

- Prevalence is greater and consequences more severe in developing countries
- Primary cause is poverty
 - o “poorest poor”
 - Characteristics of this vulnerable group
 - Consequences of malnourishment
- Poverty causes hunger; hunger worsens poverty
- Food shortages
 - o Famine – causes
 - o Political turbulence
 - o Armed conflicts
 - o Natural disasters – international food relief programs

Malnutrition

- Prevalence of persistent hunger and malnutrition
- Nutrients likely to be lacking
 - o Iron – iron deficiency anemia
 - o Iodine – stillbirths and cretinism
 - o Vitamin A - blindness and growth retardation
- Underweight children
 - o Malnourished
 - o Readily develop diseases of poverty
 - o Most of these children do not die from hunger of malnutrition

- Diarrhea and dehydration
- Oral rehydration therapy (ORT)

Diminishing Food Supply

- Demand for food continues to increase
- Crop yields have leveled off
 - Environmental degradation
 - Dwindling water supplies
- No part of the world is safe from future food shortages

Poverty and Overpopulation

- World's population is rising at an alarming rate
 - Threatens earth's capacity for safe water and adequate food
 - Much of increase is occurring in developing countries
- Population stabilization
 - Benefits
 - Poverty
- Population growth leads to hunger and poverty
 - Direct and indirect effects
- Hunger and poverty lead to population growth
 - Consequences of poverty
 - Children are an economic asset
- Breaking the cycle
 - Drop in death rate – better access to health care, education, and family planning
 - Birthrate falls – improvements in living standards
 - Education for both genders

The Global Environment

- Hunger
 - Problem of unequal distribution
 - World's increasing population
 - Food prices
- Hunger and environment connections
 - Producing enough food to feed the world damages the environment
 - A damaged environment cannot adequately support production of enough food

Hunger and Environment Connections

- Planting crops
 - Loss of native ecosystems and wildlife
 - Application of fertilizers
 - Nonpoint source of water pollution
 - Herbicides and pesticides
 - Risk to farm workers
 - Salt accumulation
- Raising livestock
 - Loss of native plants and animals, soil erosion, water depletion, and desert formation
 - Waste problems
 - Feeding of livestock
- Fishing
 - Environmental costs
 - Energy intensive
 - Bioaccumulation
- Energy overuse
 - Burning fossil fuels
- Water misuse
 - Responsible for estimated 70% of the pollution in US rivers and streams
- Biodiversity

- Failure to conserve species diversity
- Our food production systems are not sustainable

Sustainable Solutions

- Agricultural practices adapted to meet needs of local areas are being considered
 - Most sustainable practices are not really new
- Sustainable development
 - Poor nation approaches
 - Rich nation approaches
- Sustainable actions

Choice: Animal or vegetable?

- Eat low on the food chain
 - More foods derived from plants
 - Grains
 - Fruits and vegetables
 - Animal derived foods

Choice: Global or Local?

- Transport of food items
 - Average 1500 miles
 - Ramifications
- Locally grown products
 - Ecological responsibility
- Eco-friendly miles