

NUTRITION

&



Dr. Samson Davis Padayatty

Asso. Professor, Department of Zoology

S. H. College, Thevara



What is nutrition?

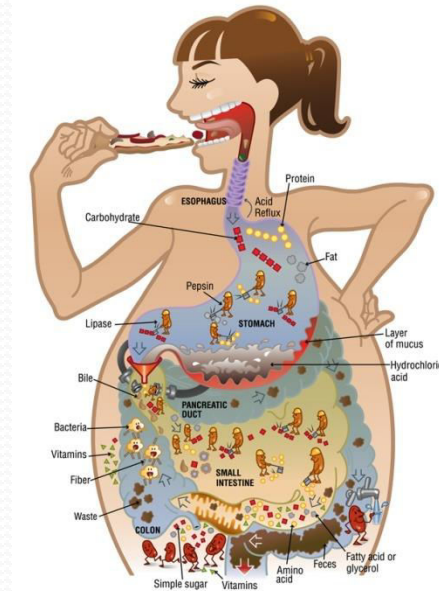
Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by nutrients in body growth, development and maintenance .



Nutrition

is a process which includes

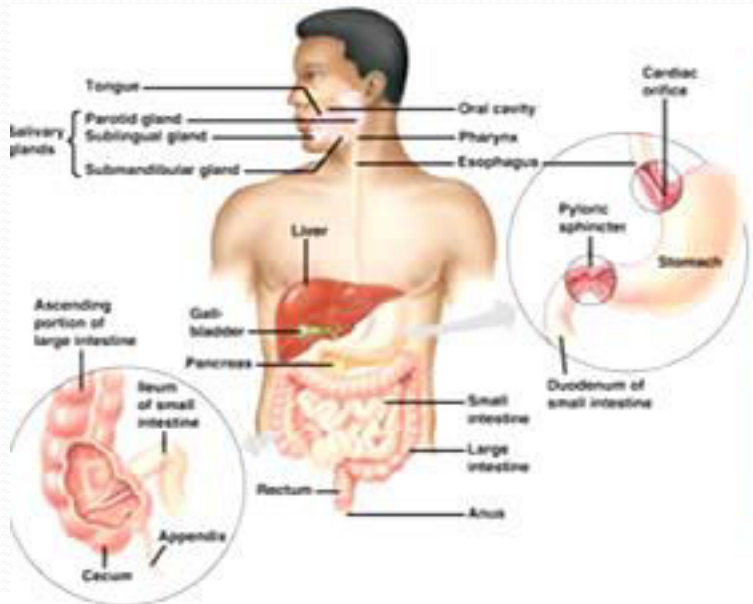
- Ingestion of food
- Its Digestion



Nutrition

is a process which includes

- Assimilation of food
- Utilization for maintenance of the body.





The word

nutrient or “food factor” is used for specific dietary constituents such as

proteins, vitamins and minerals.

Dietetics is the practical application of the principles of nutrition; it includes the planning of meals for the well and the sick.



‘Good nutrition’ means “maintaining a nutritional status that enables us to grow well and enjoy good health.”

FOOD - ?

any nutritious substance that people or animals eat or drink or that plants absorb in order to maintain life and growth.



FOOD STUFFS – nutrients required for the body

- **Carbohydrates**

- **Proteins**

- **Fats or lipids**

- **Vitamins & minerals**

- **Water**

- **Roughage**



FOOD STUFFS – CARBOHYDRATE



FOOD STUFFS – CARBOHYDRATE

Molecules made up of Carbon, Hydrogen and Oxygen
Most abundant organic molecules in nature

Mainly two categories

Sugars – simple carbohydrates

- **Glucose**
- **Fructose (fruit sugar)**
- **Lactose (milk sugar)**
- **Sucrose (cane sugar)**

Starch – complex carbohydrates made up of repeating units of simple sugars



FOOD STUFFS – CARBOHYDRATE

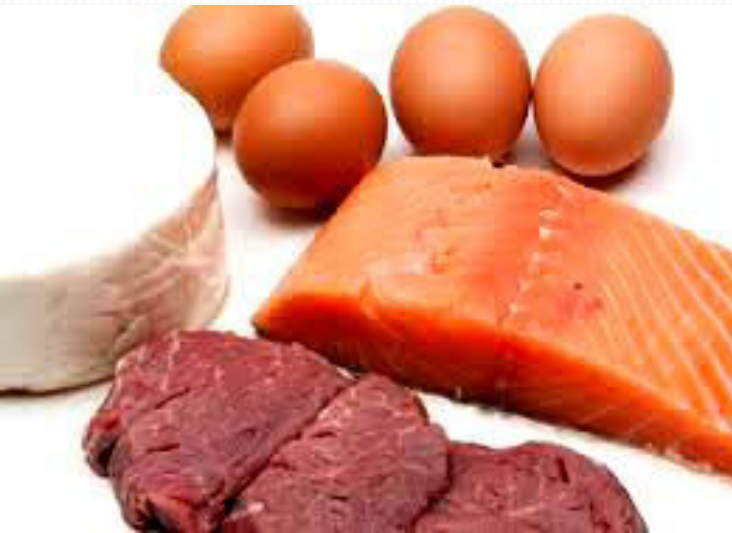
Functions as a nutrient

- Ready source of energy
- Can be stored for future use in liver and muscle
- Excess carbohydrate may transform into fat and may use to produce energy if carbohydrates are not available

Important sources



FOOD STUFFS – PROTEIN



FOOD STUFFS – PROTEIN

- **Body building**
- **Repair and maintenance of body tissues**
- **Synthesis of bioactive substances and other vital molecules**



FOOD STUFFS – PROTEIN

Important sources



FOOD STUFFS – FATS/ LIPIDS



FOOD STUFFS – FATS/ LIPIDS

- **They are high energy foods, providing as much as 9 kcal for every gram.**
- **Fats serve as vehicles for fat-soluble vitamins**
- **Fats beneath the skin provides insulation against cold.**
- **Polyunsaturated fatty acids are precursors of prostaglandins.**

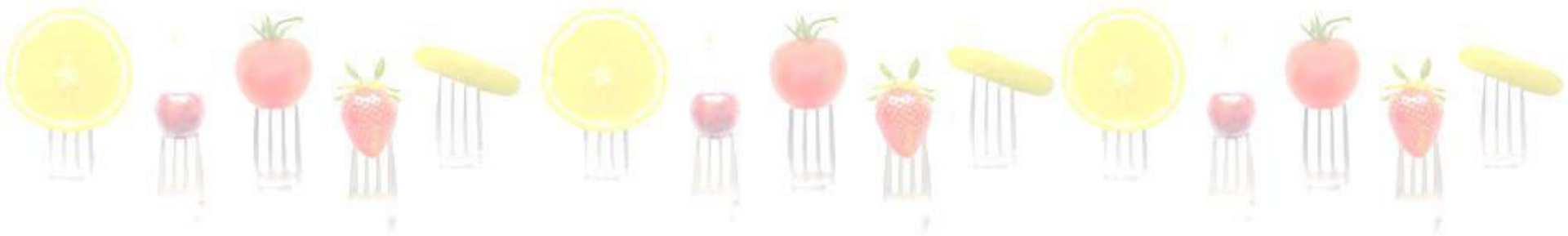


FOOD STUFFS – FATS/ LIPIDS

Important sources



FOOD STUFFS – VITAMINS



FOOD STUFFS – VITAMINS

- **Vitamins are a class of organic compounds categorized as essential nutrients. They are required by the body in a very small amounts. They fall in the category of **micronutrients**.**
- **Vitamins are divided in to two groups:**
- **fat soluble vitamins- A, D, E and K**
and
- **water soluble vitamins: vitamins of the B-complex and vitamin C.**



VITAMINS

- ENDOGENOUS Synthesis- D, K and Niacin
- DIET- all the others
- Vitamin Deficiency can be PRIMARY (diet) or Secondary (malabsorption)

VITAMIN A (RETINOL)

- Functions:
 - **Night vision**
 - **Growth and differentiation of mucus-secreting epithelium**
 - **Immunity (children)**
- Vitamin A can be stored in the liver for about 6-month supply

VITAMIN A DEFICIENCY

- Night blindness (insufficient retinal rhodopsin)
- Xerophthalmia (dry eye)- keratinized squamous epithelium replaces mucus-secreting epithelium
- Bitot spots (keratin debris) in the cornea (destruction of the cornea)
- Increased mortality in measles and diarrhea

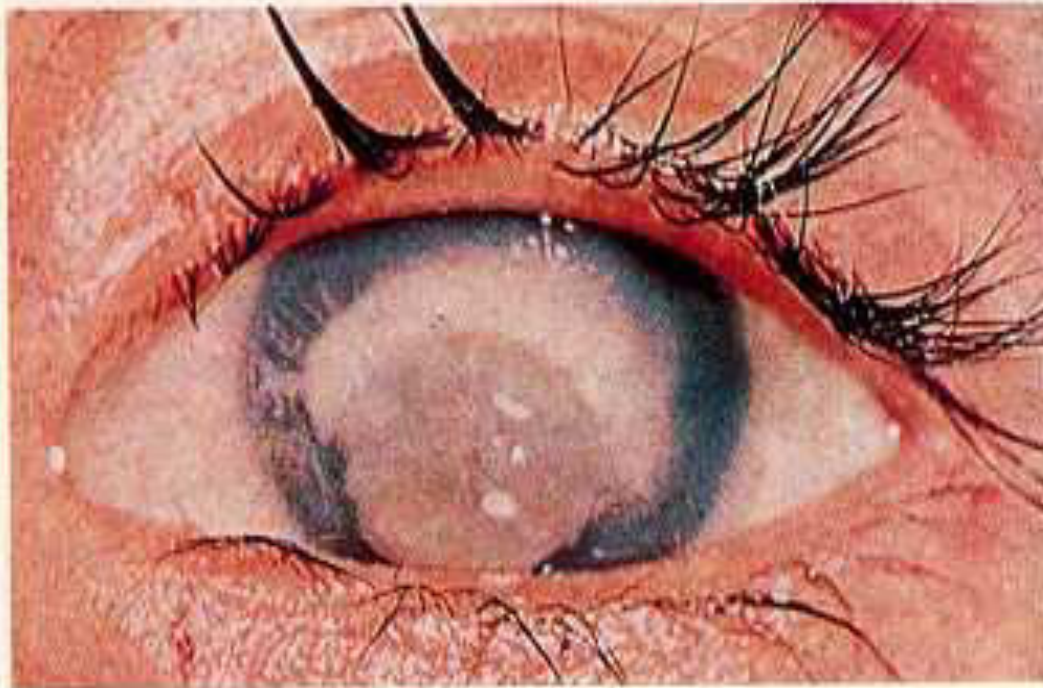


Fig. 3 Keratomalacia in a young child.

Corneal Destruction

VITAMIN D

- Major function is to maintain adequate plasma levels of CALCIUM and PHOSPHORUS

Functions

- Stimulates intestinal absorption of **calcium** and **phosphorus**
- regulate blood **calcium** levels
- Stimulates re-absorption of **calcium** in the distal renal tubule

VITAMIN D

Sources of Vitamin D

‘Sunshine vitamin’

- In addition to sunbathing:
- various fish species (salmon, sardines and mackerel, tuna, catfish, eel), fish oil, cod liver
- eggs, beef liver, mushrooms

VITAMIN D DEFICIENCY

- HYPOCALCEMIA and loss of bone: RICKETS or OSTEOMALACIA
 - Malnutrition
 - Intestinal malabsorption
 - **Inadequate sunlight exposure**
 - Liver disease
 - Renal disease





VITAMIN E

Tocopherol - “Antioxidant”

Sources of Vitamin E

- fortified cereals
- seeds and seed oils, like sunflower
- nuts and nut oils, like almonds and hazelnuts
- green leafy vegetables,
- Broccoli, cabbage, celery

VITAMIN E



Vitamin E is found in corn, nuts, olives, green, leafy vegetables, vegetable oils and wheat germ

Deficiency-

- nervous system- degeneration
- Muscle weakness
- Hemolytic anemia of premature infants

VITAMIN K

- **Help in Blood clotting**
- Vitamin K is “recycled” in the liver and gut bacteria make the vitamin, but some dietary source is required
- Green leafy vegetables
- vegetable oil
- broccoli
- cereals

Vitamin K Deficiency

- Causes
 - fat malabsorption
 - reduced gut bacterial flora
 - administration of wide spectrum antibiotics
 - neonatal period before gut is colonized
 - liver disease
- Effects of vitamin K deficiency
 - Prolonged bleeding
 - 3% prevalence of vitamin K-deficiency among neonates warrants prophylactic vitamin K therapy for all newborns

VITAMIN – B complex

THIAMINE (B1)

- Not in polished rice, white flour or refined sugar
- $\frac{1}{4}$ of all alcoholics are thiamine deficient
- Cofactor in oxidative decarboxylation → deficiency of thiamine results in DECREASED ATP
- Cardiovascular and nervous system problems

THIAMINE DEFICIENCY

Dry beriberi (polyneuropathy): myelin degeneration

Wet beriberi (cardiovascular): vasodilation produces heart failure and edema

Wernicke-Korsakoff Syndrome:

Wernicke- ataxia/confusion **Korsakoff-** amnesia, confabulation

NIACIN (B3)

- In grains, legumes and seed oils (corn-based diets)
- Deficiency of tryptophan (used to synthesize niacin)
- Important in cellular respiration and energy production

Deficiency

- PELLAGRA (3-D's)
- **dermatitis, diarrhea** (epithelial atrophy) and **dementia** (posterior column changes as in B-12 deficiency)

Niacin, Pellagra

- 3 D's of Pellagra
 - Dermatitis
 - Diarrhea
 - Dementia



Vitamin B₅ – pantothenic acid

- meat, foods of animal origin,
- yeast,
- wholemeal bread,
- broccoli, avocado
- formation of sterols (cholesterol and dehydrocholesterol).
- formation of fatty acids.
- formation of keto acids such as pyruvic acid.
- **Deficiency Rare to occur.**

Vitamin B₆ - Pyridoxine

- Vitamin B₆ is needed for more than 100 enzymes involved in protein metabolism.
- It is also essential for red blood cell metabolism and hemoglobin formation.
- The nervous and immune systems need vitamin B₆ to function efficiently.
- It is also needed for the conversion of tryptophan to niacin (vitamin B₃).

Vitamin B₆ - Pyridoxine

Signs of vitamin B₆ deficiency include:

- Skin: *dermatitis* (skin inflammation), *stomatitis* (inflammation of the mucous lining of any of the structures in the mouth), *glossitis* (inflammation or infection of the tongue).
- Vitamin B₆ deficiency also can cause anemia.

Vitamin B₇ - biotin

- liver
- meat
- kidney
- yeast
- egg yolk
- mushrooms
- milk and dairy products.

Vitamin B₇ - biotin

Prosthetic group of *pyruvate carboxylase*, *acetyl-CoA carboxylase* and other *ATP-dependent carboxylases*.

Vitamin B₉ - FOLATE (Folic acid)

- sources of animal origin - milk and milk products
- yeast
- Green vegetables

- Functions in DNA synthesis
- Deficiency in pregnant women can lead to birth defects - Neural tube defects in the fetus
- Megaloblastic anemia

- Most common vitamin deficiency in U.S.
- Certain drugs can lead to deficiency:
 - Alcohol, methotrexate, phenytoin

Cobalamin (B12)

- Only in animal products (eggs, meat, dairy)
(Strict vegetarians may face deficiency of this)
- Requires intrinsic factor for reabsorption in terminal ileum
- Stores last 3-5 years
- Functions in DNA synthesis

Deficiency

- Pernicious anemia (most common)
- Terminal ileum disease (Crohn's)

VITAMIN C (ASCORBIC ACID)

- (Citrus) fruits and vegetables
- Vitamin C is important in the formation and **maturation of procollagen**

VITAMIN C DEFICIENCY

- **SCURVY**
- Capillary and venule walls are weak with bleeding (Bleeding gums and loosened teeth)
- Trauma- hemarthrosis in joints
- Child- too much cartilage and **not enough hard bones**; bowed legs and deformed chest
- Bacterial infection associated with gum bleeding
- Bleeding and poor wound healing in children and adults

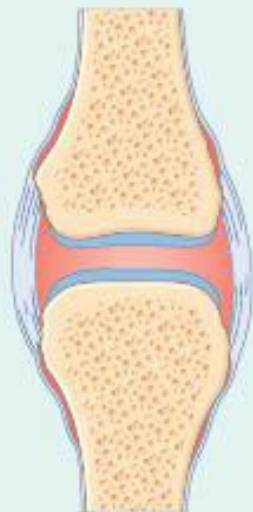
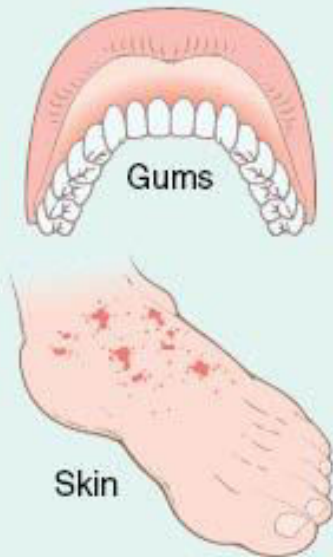
VITAMIN C DEFICIENCY



IMPAIRED COLLAGEN FORMATION

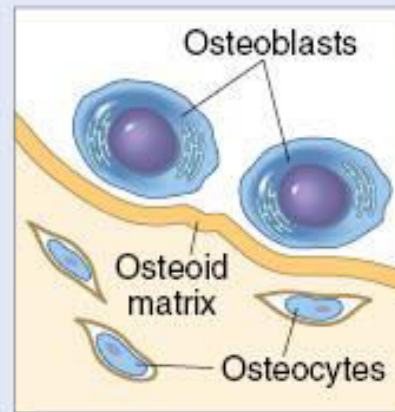


Poor vessel support results in bleeding tendency

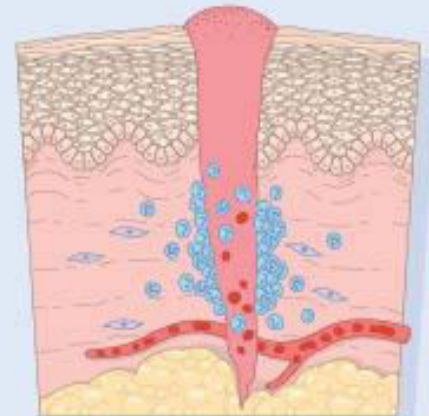


Periosteum and joints

Other effects



Inadequate synthesis
of osteoid



Impaired wound healing



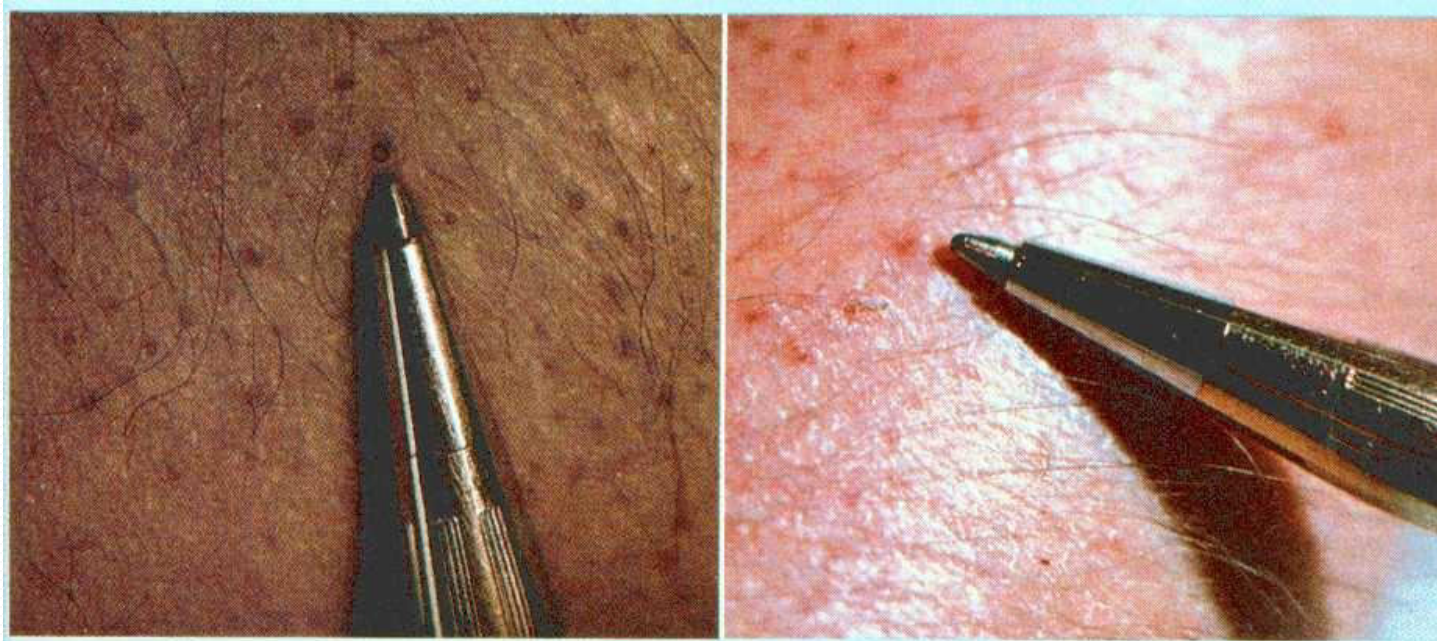


Fig. 6-2 A, Corkscrew hairs in scurvy. B, Perifollicular petechiae in scurvy.

FOOD STUFFS – MINERALS



Zinc

- Trace element
- Component of enzymes (oxidases)
- Causes of deficiency:
 - Alcoholism
 - Diabetes
 - Chronic diarrhea

Zinc Deficiency

- Dermatitis (rash around eyes, mouth, nose, etc)
- Anorexia
- Diarrhea
- Growth retardation
- Impaired wound healing
- Hypogonadism/ Infertility



© Elsevier 2005

Other Trace Elements

- **Copper:**

- Deficiency: microcytic anemia; poor wound healing
- Toxicity: Wilson's disease

- **Selenium:**

- Function: component of glutathione peroxidase
- Deficiency: dilated cardiomyopathy

- **Chromium:**

- Function: component of glucose tolerance factor and cofactor for insulin
- Deficiency: impaired glucose tolerance

Other Trace Elements

- **Iodine:**

- Function: synthesis of thyroid hormone
- Deficiency: goiter; hypothyroidism

- **Fluoride:**

- Function: component of calcium hydroxyapatite in bone and teeth
- Deficiency: dental caries
- Excess: chalky deposits on teeth; calcification of ligaments

FOOD STUFFS – WATER



70 % of our body made up of water
Essential for all chemical reactions in our body
Maintenance of osmotic pressure
Essential for cleaning of metabolic wastes

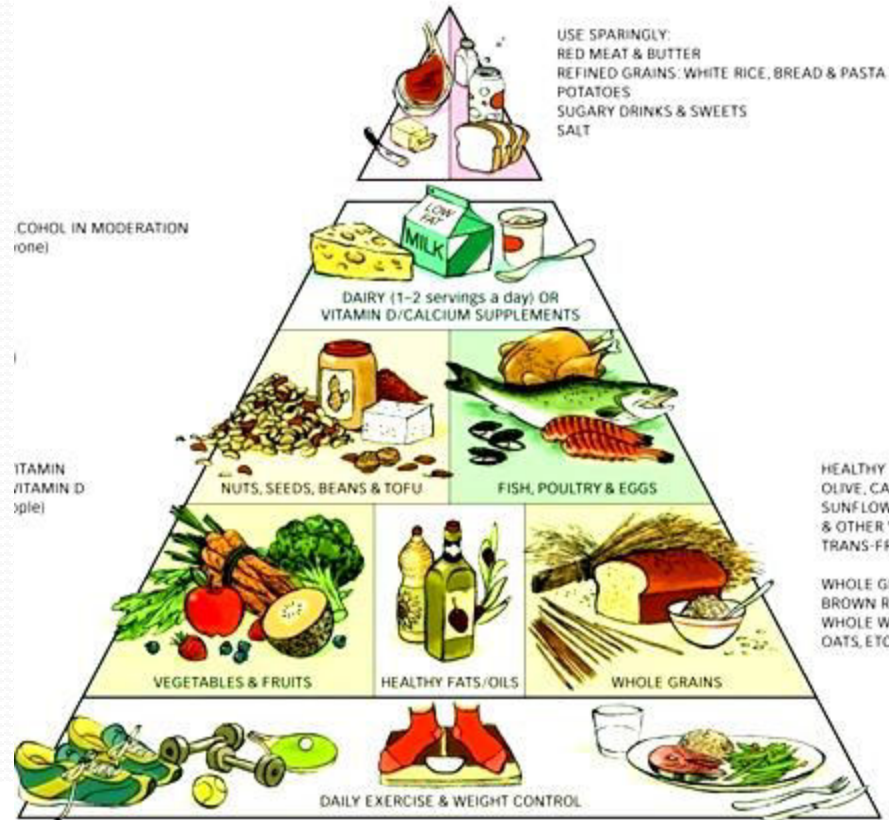


FOOD STUFFS – ROUGHAGE

Dietary fibre which is mainly non-starch carbohydrate is an important component of the diet. It is found in vegetables, fruits and grains. It may be divided broadly into cellulose and non-cellulose types. These are all degraded to a greater or lesser extent by the micro flora in the human colon. Main components which act as roughage are hemicellulose, pectin, inulin, plant gums and mucilage.



BALANCED DIET





Malnutrition

- Also called “protein energy malnutrition”
- Results from inadequate intake of proteins and calories or problems with digestion/malabsorption of proteins
- 2 main forms:
 - Marasmus
 - Kwashiorkor

Two protein compartments

- Somatic compartment:
 - Proteins in skeletal muscle
 - Reduced circumference of mid-arm
 - Affected more by **marasmus**
- Visceral compartment:
 - Protein stores in visceral organs (mostly liver)
 - Decrease in serum proteins (albumin)
 - Affected more by **kwashiorkor**

MARASMUS

- < 60% body weight
- Diet lacks protein & carbohydrate
- **Loss of muscle mass (somatic protein)**- amino acids for energy
- Loss of subcutaneous fat
- **Serum proteins (visceral compartment)**
NORMAL
- **EMACIATION**- loss of muscle and fat

MARASMUS

- Head appears too large; “stick figure”
- Multiple vitamin deficiencies coexist
- Immune deficiency



Child with marasmus.





From "Fundamentals of Clinical Nutrition" by R. L. Weinsier copyright 1993 by Mosby-Year Books N.Y.

Fig. 9-2 (A–E) Losses of subcutaneous fat reserves and muscle mass in patients with marasmus.

KWASHIORKOR

- **Protein deprivation** > caloric deprivation
- ****₂nd birth** First child is weaned too soon and put on a high carbohydrate diet
- **MORE dangerous** than Marasmus
- Severe loss of visceral protein
- **Hypoalbuminemia** causes generalized EDEMA which can mask the loss of weight
- Subcutaneous fat and muscle are SPARED

SIGNS OF KWASHIORKOR

- Flaky Paint Skin- alternating zones of hypo- and hyper-pigmentation
- Hair loss or color change
- **FATTY LIVER-** also **small intestine atrophy** with loss of villi
- **PITTING EDEMA**

Signs Continued...

(Seen in both marasmus & kwashiorkor)

- Growth failure
- Multivitamin deficiencies
- Immune defects and infections
- Anemia- usually hypochromic/microcytic
- Cerebral atrophy in infants



© Elsevier 2005