

BIOCHEMISTRY OF NUTRITION

Assoc. prof. M.N.Kurbat

Nutritiology (from the greek “*nutricia*” - food) - science about foods, nutrients and other components in food, their interactions and role in maintaining health or disease, the processes of consumption, uptake, transport, utilization (spending) and excretion.

CLASSIFICATION OF FOODS

- *Classification by origin:*
 - **Foods of animal origin**
 - **Foods of vegetable origin**
- *Classification by chemical composition:*
 - **Fats**
 - **Proteins**
 - **Carbohydrates**
 - **Vitamins**
 - **Minerals**

Main principles of nutrition

1. Caloric intake should provide the body energy costs, which depend on age, gender, type of physical or mental activity (for students of 2200-3000 kcal/day).

2. Rational ratio of proteins, fats and carbohydrates, which for the average person is 1:1,5:4. Most of the food carbohydrates constitute mainly of plant origin.

Usual daily ration comprises **400-500 g carbohydrates**

- 60-80% are polysaccharides (mainly starch, a lesser amount - glycogen and fiber -cellulose)
- 20-30% of oligosaccharides (sucrose, lactose, maltose)
- the rest quantity - monosaccharides (glucose, fructose and pentose).

Approximately equal ratios of dietary **fat (100 g/day)** should be present saturated, monounsaturated and polyunsaturated fatty acids.

Normal nutritional amount of **protein from 80 to 100 g/day**, and it should be ensured as proteins of plant origin and animal (in equal parts).

Main principles of nutrition

3. Food essential components, many of which are present in minimal quantities (minor substances) essential amino acids, essential fatty acids (linoleic, linolenic, arachidonic), vitamins, minerals, fiber, flavoring components, essential oils, as well as water.
4. Mode of eating, which includes the multiplicity of reception and distribution of the daily diet, morning - dinner - evening.
5. Match diet physiological (or pathological) status of the organism (restriction of carbohydrates in diabetes, proteins - with renal disease, lipids - in atherosclerosis).
6. Food must be subjected to cooking to increase the organoleptic properties and safety to the organism.

General characteristics of the main components of food

PROTEINS

- Proteins are complex organic nitrogenous compounds.
- They also contain sulfur and in some cases phosphorous and iron.
- Proteins are made of monomers called amino acids.
- There are about 20 different amino acids which found in human body.
- Of this 8 amino acids are termed “essential” as they are not synthesized in human body and must be obtained from dietary proteins.

Functions of Proteins

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

Assessment of Protein nutrition status

- **Protein nutrition status is measured by Serum Albumin Concentration.**
- **It should be more than 35 g/l.**

Less than 35 g/l shows mild malnutrition.

Less than 30 g/l shows severe malnutrition.

FAT

Most of the body fat (99 per cent) in the adipose tissue is in the form of triglyceroles, in normal human subjects, adipose tissue constitutes between 10 and 15 per cent of body weight. One kilogram of adipose tissue corresponds to 7700 kcal of energy.

Essential fatty acids are those that cannot be synthesized by humans

Dietary sources of Essential fatty acids

- ***Linoleic acid***

Sunflower oil Corn oil Soya bean oil Sesame oil
Groundnut oil Mustard oil Palm oil Coconut oil

- ***Arachidonic acid***

Meat, eggs, milk

- ***Linolenic acid***

Soya bean oil, Leafy greens

Functions of fats

- **They are high energy foods, providing as much as 9 kcal for every gram.**
- **Fats serve as vehicles for fat-soluble vitamins**
- **Fats in the body support viscera such as heart, kidney and intestine; and fat beneath the skin provides insulation against cold.**

The “non-calorie” roles of fat

- vegetable fats are rich sources of essential fatty acids which are needed by the body for growth, structural integrity of the cell membrane and decreased platelet adhesiveness.
- Diets rich in essential fatty acids have been reported to reduce serum cholesterol and low density lipoproteins.
- Polyunsaturated fatty acids are precursors of prostaglandins.

CARBOHYDRATE

Carbohydrate is the main source of energy, providing 4 Kcals per one gram.

Carbohydrate is also essential for the oxidation of fats and for the synthesis of certain non-essential amino acids

Sources of carbohydrates

There are three main sources of carbohydrate, are starches, sugar and cellulose.

The carbohydrate reserve (glycogen) of a human adult is about 500g. This reserve is rapidly exhausted when a man is fasting. If the dietary carbohydrates do not meet the energy needs of the body, protein and glycerol from dietary and endogenous sources are used by the body to maintain glucose homeostasis.

Dietary fibre

Dietary fibre which is mainly non-starch polysaccharide is a physiological important component of the diet.

It is found in vegetables, fruits and grains. It may be divided broadly into cellulose and non-cellulose polysaccharides which include hemicellulose pectin, storage polysaccharides like inulin, and the plant gums and mucilage. These are all degraded to a greater or lesser extent by the micro flora in the human colon.

MALNUTRITION

- Malnutrition essentially means *“bad nourishment”*. *It concerns not enough as well as too much food, the wrong types of food, or the inability to use nutrients properly to maintain health.*
- The World Health Organization cites malnutrition as the greatest single threat to the world's public health.
- Malnutrition in all its forms is a considerable public health concern and is associated with increases risk of disease and early death.

MALNUTRITION

- The World Health Organization defines malnutrition as *"the cellular imbalance between supply of nutrients & energy and the body's demand for them to ensure growth, maintenance, and specific functions"*.
- Malnutrition comprises both;
 1. Under nutrition
 2. Over nutrition

TYPES OF MALNUTRITION

- *Under nutrition is depletion of energy (calories)* resulting from insufficient food intake over an extended period of time.
- In extreme cases under-nutrition is called *Starvation*. While *Famine* is severe food shortage of a whole community.
- *Specific Deficiency* is the pathological state resulting from a deficiency of an individual nutrient such as vitamin A deficiency, iodine deficiency.

TYPES OF MALNUTRITION

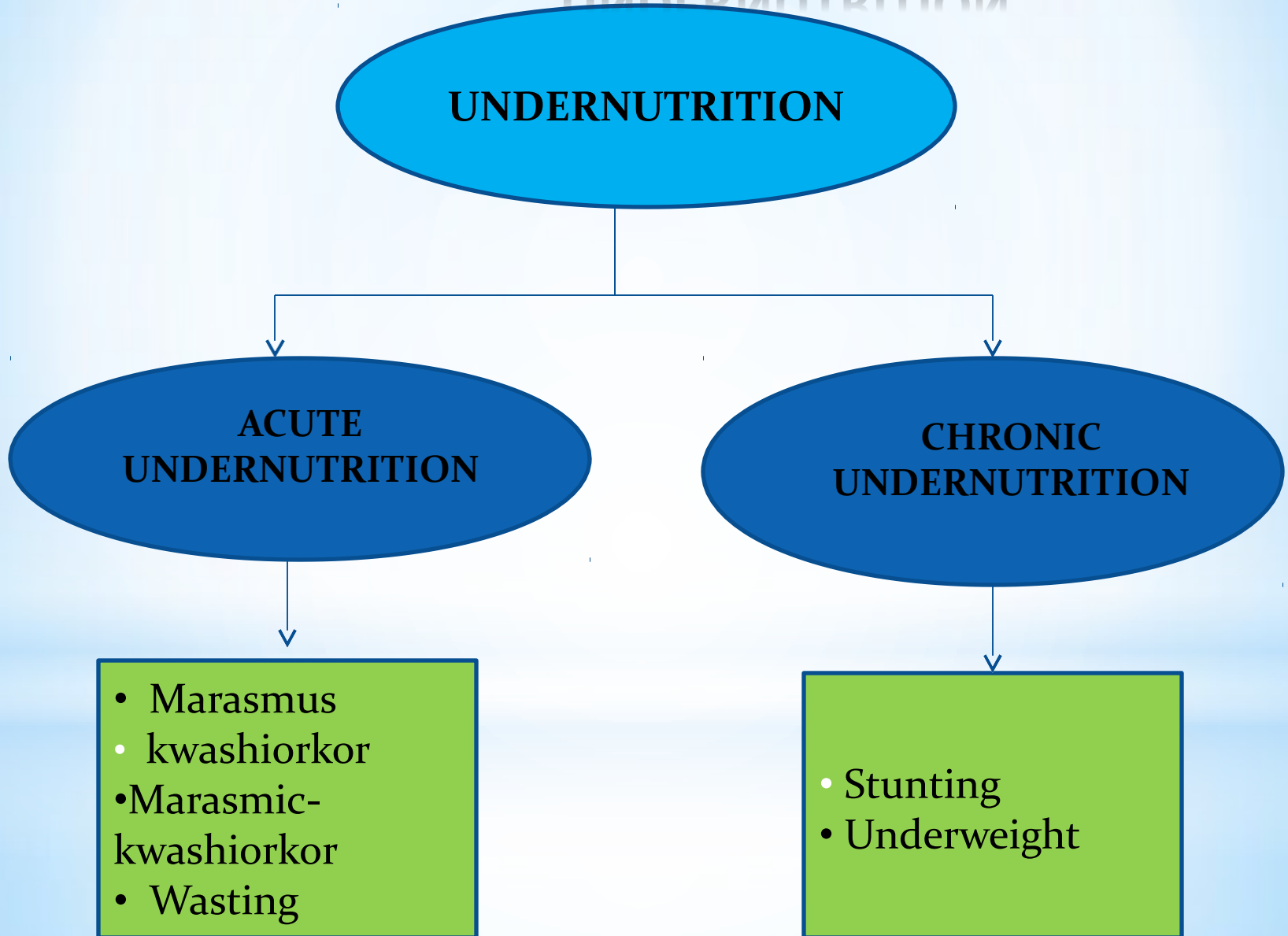
- *Over nutrition:*
- Many tend to think malnutrition only in terms of hunger, however, overeating is also a contributing factor.
- *“Over nutrition is the pathological state resulting from the consumption of excessive quantity of food over an extended period of time”.*
- Overweight and obesity are very common conditions in developed society and are becoming more common in developing societies and those in transition.

NUTRITIONAL DEFICIENCY DISEASES

On global scale the five principal nutritional deficiency diseases are:

1. Kwashiorkor
2. Marasmus
3. Xerophthalmia
4. Nutritional anemia
5. Endemic goiter

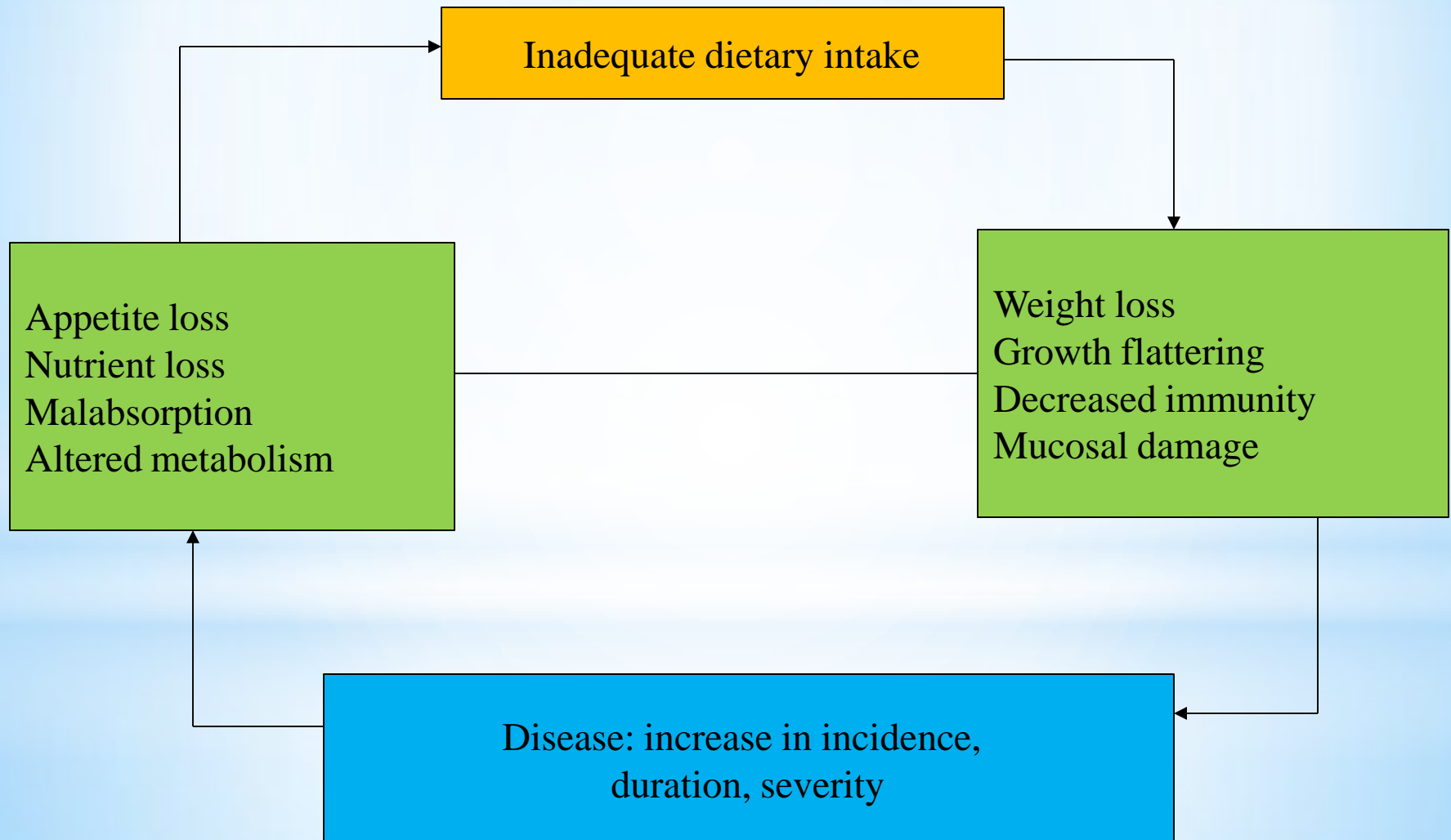
* TYPES OF UNDERNUTRITION



MALNUTRITION AND SOME DEFINITIONS

| Acute malnutrition | Description |
|------------------------------------|--|
| <i>Kwashiorkor</i> | Kwashiorkor is a severe form of <i>acute malnutrition</i> . It is characterized by clinical signs including oedema (swelling due to water retention) beginning in the lower legs and feet and which can spread to other parts of the body. Other signs include cracked and peeling skin, changes in hair colour (lightening) and texture, lethargy and misery. |
| <i>Marasmus</i> | Marasmus is a severe form of <i>acute malnutrition</i> . Marasmic individuals have the clinical signs of extreme thinness, often with flaccid skin, hanging in loose folds to give an 'old man's appearance'. Marasmic individuals may be alert but irritable. |
| <i>Marasmic-kwashiorkor</i> | Marasmic-kwashiorkor is a severe form of <i>acute malnutrition</i> when an individual shows clinical signs of both marasmus and kwashiorkor |
| <i>Wasting</i> | Wasting is a form of <i>acute malnutrition</i> . Wasted individuals are too light for their height (very thin). |
| Chronic malnutrition | |
| <i>Stunting</i> | Stunting is a form of <i>chronic malnutrition</i> that arises when an individual is too short for their age and occurs in the first 2 to 3 years of life. Levels of stunting are likely to increase in chronic emergencies. |
| <i>Underweight</i> | Underweight individuals are too light for their age (maybe short or thin or both). |

MALNUTRITION CYCLE



MANIFESTATIONS OF UNERNUTRITION

- Under nutrition results in the loss of body weight. The loss of weight is a manifestation of energy depletion.
- Malnutrition from any cause retards normal growth. Malnourished children grow up with worse health and lower educational achievements.
- Decrease in immunity increases the susceptibility to infections, which add to the morbidity and mortality.
- Malnutrition is also associated with lowered vitality of the people leading to lowered productivity and reduced life expectancy.

MANIFESTATIONS OF OVERNUTRITION

- In the more developed countries of the world, over nutrition is encountered much more frequently than under nutrition.
- The health hazards from overnutrition are:
 1. Obesity
 2. Diabetes
 3. Hypertension
 4. Cardiovascular diseases
 5. Renal diseases
 6. Disorders of liver and gall bladder