

Macro and Micronutrients

OVERVIEW:

- What are macro and micronutrients?
- Types
- Functions
- Sources and RDAs
- Diseases and conditions due to their deficiency

NOTE:

RDA: Recommended dietary allowance



Biochemistry433@hotmail.com

Nutrients needed by the body in :

Small amount

Large amount

MICRONUTRIENTS

- ❑ (Vitamins, Minerals, trace elements)
- ❑ Required for maintaining normal health and preventing various diseases (do not provide energy)

MACRONUTRIENTS

- ❑ (proteins, carbohydrates, fats)
- ❑ They provide energy and building blocks for proteins, CHO and fats

Energy content of food

- ✓ Body obtains energy as “**ATP**” which is used for all body functions
- ✓ The energy content of food is measured in **calories (Kilocalories)**
- ✓ One calorie **is the heat required to raise the temperature of 1 gm. of water by 1°C**
- ✓ **Proteins** => **4** kcal/gm
- ✓ **Carbohydrates** => **4** kcal/gm
- ✓ **Fat** => **9** kcal/gm

Meat, poultry, fish, milk, wheat, corn, beans, nuts

Source

PROTEINS

Nutritional importance

supply amino acids and amino nitrogen for the body

Essential AA:

Body can't synthesize (must be supplied in the diet)

PVT TIM HALL:

Phenylalanine, Valine, Tryptophan, Threonine, Isoleucine, Methionine, Histidine, Arginine, Lysine, Lucine

Types

Non-essential AA:

body can synthesize

Nutritional Quality of Proteins

A measure of a protein's ability to provide the essential amino acids required for tissue maintenance

Measured in PDCAAS units

(Protein digestibility-Corrected Amino Acid Scoring)

High value indicates more digestibility and high quality (maximum score 1.0)

- Proteins from animal sources: 0.82-1.0
- Proteins from plant sources: 0.4

Nitrogen balance

Condition	Definition	Occur in
Normal	Nitrogen intake = Nitrogen loss	Healthy person
Positive	Nitrogen intake > Nitrogen loss	Growth, pregnancy, lactation, recovery from illness
Negative	Nitrogen loss > nitrogen intake	Burns, trauma, illness, metabolic stress

Malnutrition

A condition or disease caused by not eating enough food or not eating a balanced diet

Two conditions: Marasmus & Kwashiorkor

Condition	Marasmus	Kwashiorkor
The cause	Inadequate energy intake	Inadequate protein intake
Age	1-3	After weaning (فطام)
Food intake	Mother's milk + cereals (deficient in calories)	CHO mainly
Symptoms	Arrested growth, Extreme muscle wasting, Weakness, weight loss, <u>NO edema</u> . ¹	<u>Edema</u> ² , Distended abdomen <u>Diarrhea</u> , Dermatitis (thin hair) Enlarged fatty liver

1. Adequate protein intake => No changes in plasma proteins

2. Inadequate proteins intake => Low plasma albumin => Edema

130 grams/day for adults and children

Simple CHO:
sucrose, fructose,
lactose, corn syrup

Types
in diet

Carbohydrates

RDA

Complex CHO:
whole grains, pasta,
wheat, starch

Role in diet

1. Energy production.
2. Protein-Sparing Effect:
They inhibit gluconeogenesis from amino acids therefore, amino acids are used for repair and maintenance of tissue protein and not for gluconeogenesis

If CHO
intake is:

> RDA => ↑ Fat storage in adipose tissue => Weight gain

< RDA => ↑ Proteins metabolism=> ↑ Gluconeogenesis

Dietary fibers

Definition:

The component of food that cannot be broken down by human digestive enzymes

Benefits:

- ↓ serum LDL levels
- ↓ constipation
- Promotes feeling of fullness
- Slows gastric emptying
- ↓ exposure of gut to carcinogens

Dietary fats

RDA= (Total fats: 65, Saturated: 20)

concentrated source of energy (9 kcals/gram)

Supply essential fatty acids such as linoleic and linolenic acids

Provide phospholipids for membrane function

Source of fat-soluble vitamins (A, D, E, K) and help in their absorption

Excessive fat intake

Atherosclerosis/heart disease
Obesity

scaly skin
Dermatitis
Reduced growth (common in infants)

Deficiency

2 Essential Fatty Acids

Fatty acid	a-linolenic acid (w-3 fatty acid)	linoleic acid (w-6 fatty acid)
Sources	<ul style="list-style-type: none"> ❑ cold-water ocean fish such as: albacore, mackerel, salmon, sardines, tuna, whitefish ❑ Plants ❑ Fish oil¹ 	<ul style="list-style-type: none"> ❑ Nuts (مكسرات) ❑ Avocados ❑ Olives ❑ Soybeans (فرل الصويا) ❑ Oils (sesame سمسم, cottonseed, corn oil)
Effects	<ul style="list-style-type: none"> ➤ Structural membrane lipids ➤ Modulate w-6 fatty acid metabolism ➤ <u>Suppress cardiac arrhythmias</u> ➤ ↓ Serum TAG ➤ ↓ Tendency to thrombosis ➤ ↓ blood pressure ➤ ↓ Risk of cardiovascular mortality ➤ Little effect on LDL or HDL levels 	<ul style="list-style-type: none"> ➤ ↓ Plasma cholesterol ➤ ↓ LDL ➤ ↓ HDL
Both are used for	<p><u>Eicosanoids² synthesis</u> which appear to have cardio-protective effects</p> <ul style="list-style-type: none"> ✧ ↓ Blood clotting ✧ ↓ Blood pressure 	

1. Which contain docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)
2. Signaling molecules derived from either omega-3 (ω -3) or omega-6 (ω -6) fatty acids

Unsaturated fatty acids, behaving more like saturated fatty acids in the body

- ❑ ↑ Serum LDL
- ❑ Risk of CVD

Effect

Trans Fatty Acids¹

Definition

Found in

Formed during hydrogenation of liquid vegetable oils

- ✓ Animals only (not found in plants)
- ✓ Baked food: cookies, cakes, deep-fried foods

1. Food makers uses artificial trans fats to enhance the flavor.

Vitamins

- Organic compounds present in small quantities in different types of food
- Important for growth and good health
- Essential & Noncaloric
- Required in very small amounts
- Fat-Soluble Vitamins: A, D, E, and K (stored in the body)
- Water-Soluble Vitamins: B, C and all the other vitamins

Minerals And Trace Elements

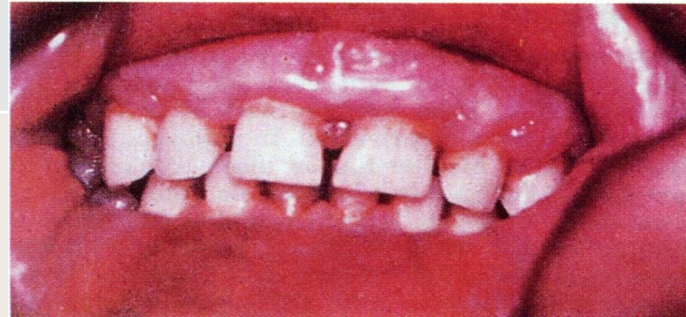
- Macrominerals (<100 mg/day)
 - Calcium
 - Phosphorous
 - Sodium
 - Potassium
 - Chloride
 - Magnesium
- Microminerals: (<100 mg/day)
 - Iron
 - Iodine
 - Copper
 - Manganese
 - Zinc
 - Cobalt

Vitamin B1 (thiamin)

Functions	Deficiency	Sources	Note
<p>Co enzyme for:</p> <ul style="list-style-type: none"> ☐ transketolase ☐ oxidative decarboxylation reactions <p>** In thiamin deficiency, the activity of these two dehydrogenases is decreased Causing:</p> <ul style="list-style-type: none"> ✓ Low ATP production ✓ Defective cellular function 	<ul style="list-style-type: none"> • Wernicke-karsakoff syndrome: causes apathy & loss of memory. <u>common in alcoholics</u> due to defective intestinal absorption of thiamin or dietary insufficiency 	<ul style="list-style-type: none"> • Plants • Cereals • meat 	<p>Active form: Thiamin pyrophosphate (TPP)</p>
<p>Nerve conduction</p>	<ul style="list-style-type: none"> • Beriberi: <u>weakness, neuropathy, disorderly thinking & paralysis.</u> <p>These happen because of neuropathy affects glial cells of brain and spinal cord causing <u>neuronal death.</u></p>		

Vitamin C

Functions	Deficiency	Sources
<ul style="list-style-type: none"> • <u>Helps in dentine</u> (Helps in collagen formation) • <u>↑ iron absorption</u> → maturation of RBCs • <u>Powerful antioxidant</u> → prevents cancer • Promote wound healing • Stimulates phagocytosis of leukocyte • <u>↓Risk of cataract formation</u> 	<ul style="list-style-type: none"> • Scurvy: abnormal collagen production → Gums become swollen & spongy. → Teeth are lost. 	<ul style="list-style-type: none"> • Citrus fruits • Tomatoes • peppers



Vitamin E

Functions	Deficiency	Sources	Note
<u>Anti-oxidant & Anti-aging</u>	<ul style="list-style-type: none"> • Anemia due to RBCs damage • Neurological problems • Defective lipid absorption 	Vegetable oil, nuts, seeds & vegetable	Active form: α -tocopherol
Role in fertility	Male infertility		

Iron

Functions	Deficiency &	Sources	Note
<ul style="list-style-type: none"> • Oxygen transport (part of hemoglobin, myoglobin & cytochromes) 	<ul style="list-style-type: none"> • Iron deficiency anemia: (most common) <u>Occur in growing children, pregnant, lactating and menstruating women (they need more iron).</u> • Hemosiderosis¹ (iron overload disorder): <ul style="list-style-type: none"> ❑ <u>Due to Iron toxicity.</u> ❑ <u>Common in persons receiving repeated blood transfusions.</u> 	<ul style="list-style-type: none"> • Heme iron: animal products (meat, liver) • Nonheme iron: plants 	Body stores iron as <ol style="list-style-type: none"> 1. ferritin, 2. Hemosiderin 3. transferrin.

1. Hemosiderin: Iron stored with ferritin in liver and spleen.

1- Which of the following is an importance of macronutrients ?

- A- maintaining normal health
- B- providing energy
- C- cell metabolism
- D- preventing diseases

2- which of the following is a body essential amino acid ?

- A- phenylalanine
- B- glutamate
- C- asparagine
- D- proline

3- what is meant by negative nitrogen balance?

- A- nitrogen loss is equal to its intake
- B- nitrogen is present in excess amounts in the bod
- C- nitrogen loss is more than intake
- D- nitrogen intake is more than loss

4- A 3 year old child was presented by his mother to the general practitioner with weight loss and weakness. Upon examination she was found to suffer from extreme muscle weakness. What is the most likely diagnosis?

- A- kwashiorkor malnutrition
- B- marasmus malnutrition

5- which of the following is a consequence of excess CHO in the diet?

- A- increased metabolism rate
- B- increased energy
- C- increased muscle strength
- D- increased fat storage

6- which of the following slows gastric emptying ?

- A- polypeptides
- B- monosaccharides
- C- dietary fibers
- D- fatty acids

7- A 30 year old patient was presented to the general practitioner with dermatitis and scaly skin. The most probable cause of his symptoms is?

- A- essential protein deficiency
- B- essential fatty acid deficiency
- C- essential CHO deficiency
- D- excess protein intake

8- TPP is the active form of which of the following?

- A- vit. B1
- B- vit. E
- C- vit. C
- D- iron

9-wernicke-koraskoff syndrome results from?

- A- excessive alcohol intake
- B- alcohol intake during pregnancy
- C- drug abuse
- D- excessive vit B1

10- A patient was presented with anemia, delayed wound healing and cataract. What is the best treatment to his symptoms?

- A- administration of vit b1
- B- administration of vit e
- C- administration of vit k
- D- administration of vit c

11-which of the following is a micronutrient?

- A- chloride
- B- calcium
- C- iron
- D- potassium

12- which ONE of the following lowers TAG level in blood?

- A. omega-3 FA
- B. omega-6 FA
- C. trans fatty acids
- D. vitamin E

13- which ONE of the following conditions is related to Folic acid deficiency ?

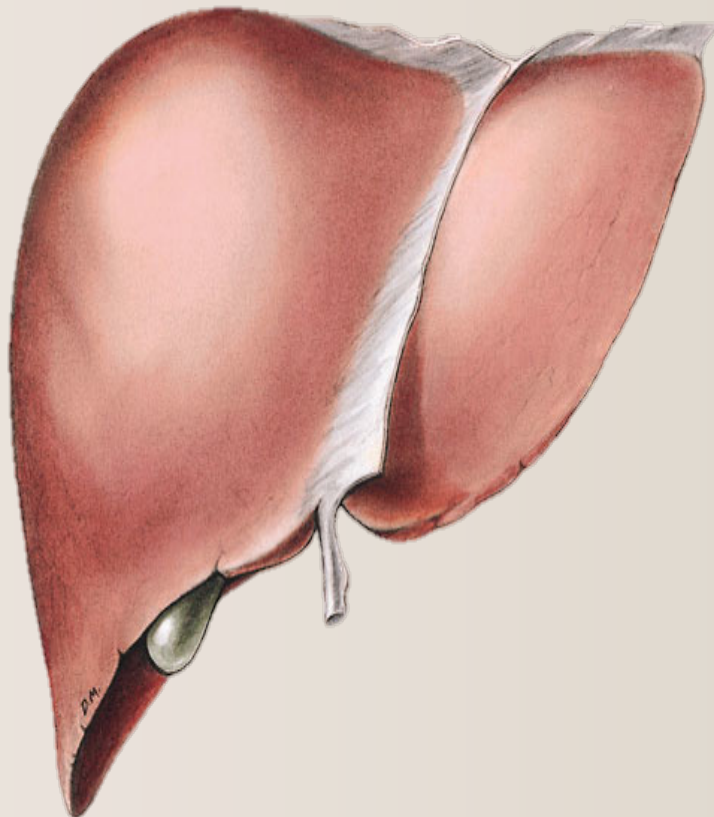
- A. megaloblastic Anemia
- B. osteoporosis
- C. Beriberi
- D. Scurvy

14- which of the following is symptoms of Kwashiorkor

- A- Arrested growth
- B- Weight loss
- C- Enlarged fatty liver & edema
- D- Extreme muscle wasting

15- vitamin E deficiency is manifested by all of the following except ..?

- A. Defective lipid absorption
- B. Anemia due to oxidative damage to RBCs
- C. Neurological problems
- D. loss of memory



Thank You!

Done by:
Mohammed AlNafisah
Basmah AlDeghaither
Sara aldokhayel
Ziyad Alajlan