**بسم الله الرحمن الرحيم**

**nutrationهذي المذكرة كتبناها ورا الدكتور في باب**

**والحمدلله تمت طباعتها وان شا الله تعجبكموتساعدكم على المذاكره بدل الكتاب**

**سووري عالاخطاء الاملائيه اللي فيها واعذرونا عالتأخيرواعذرونا ما امدانا نحط الفيقرز**

**(قروب الخيمة ض1) Bio teamمع تحيات**

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# NUTRITION

**Nutrients** are the constituents of food necessary to sustain the normal functions of the body.

**Nutrients** are compounds that provide body with energy & essential molecules such as amino acids, fatty acids, vitamins, and minerals.

Energy is provided by macronutrients which are carbohydrates, fats & proteins. F 27.1

**Dietary Reference Intakes (*DRIs*)**

They are estimates of the amounts of nutrients required to prevent deficiencies & maintain optimal health.

***DRIs*** replace and expand on *Recommended Dietary*

*Allowances* (***RDAs***), published in 1941 (with periodic revisions).

***DRIs*** establish upper limits on the consumption of some nutrients and incorporate the role of nutrients in lifelong health, going beyond deficiency diseases.

Both ***DRIs*** and ***RDAs*** refer to long-term average daily nutrient intake, because it is not necessary to consume the full RDA every day

**Definition of the DRIs**

**The *DRIs* consist of four dietary reference standards for the intake of nutrients designed for specific age-groups, physiologic state, and sexes.**

1- **Estimated Average Requirement (EAR)**

***EAR*** is the average daily nutrient intake level estimated to meet the nutrient requirements of *one half the healthy individuals* in a particular life stage and gender group.

It is useful in estimating the actual requirements in groups & individuals.

2 - **Recommended Dietary Allowances (RDA)**

Is the average daily dietary intake level that is sufficient to meet the nutrient requirements of ***nearly all individuals*** (97 – 98 %) in a life stage and gender group.

***RDA*** is ***not*** the minimal requirement for healthy individuals, but it is set to provide a margin of safety for most individuals.

***EAR*** serves as the base for setting ***RDA***.

If SD of the of ***EAR*** is available and the requirement for the nutrient is normally distributed, the RDA is set at two SDs above the EAR. *RDA = EAR + 2 SD EAR .*

3- **Adequate Intake (AI)**

**-AI** is set instead of **RDA** if sufficient scientific evidence is not available to calculate an EAR or RDA.

**-AI** is based on estimates of nutrient intake by a group of apparently health people that are assumed to be adequate.

*For example*, **AI** for young infants (whom human milk is the recommended sole source of food for the first 4-6 months), is based on the estimated daily mean nutrient intake supplied by human milk for healthy full term infants who are exclusively breast-fed. F27.3

4- **Tolerable Upper intake Level (UL)**

**-UL** is the highest average daily nutrient intake level that is likely to pose **no risk** of adverse health effects to almost all individuals in the general population.

**-UL** is not used as recommended levels of intake.

**-ULs** are useful because of the increased use of dietary supplements and fortified foods.

**-ULs** apply to chronic daily use.

For some nutrient, there may be insufficient data on which to develop a **UL**.

**Using the DRIs**

1- Most nutrients have a set of ***DIRs***.

2- Usually a nutrient has an **EAR** and a corresponding **RDA**, most are set by age and gender, and may be *influenced* by special factors such as pregnancy and lactation in women.

3- When the data are not sufficient to estimate an **EAR** (or **RDA**), then an **AI** is designated

The **AI** is judged by experts to meet the needs of all individuals in a group, ***but*** is based on less data than in establishing an **EAR** and **RDA**

## **Conclusions** :

-Intakes **below EAR** need to be improved because the probability of adequacy is 50% or less.

-Intakes **between EAR and RDA** probably need to be improved because the probability of adequacy is less than 98% .

-Intakes **at or above RDA** can be considered *adequate*.

-Intake **above AI** can be considered *adequate*.

-Intakes **between UL and RDA** can be considered at *no risk* for adverse effects. F.27.4

## Energy Requirements in Humans:

-The estimated energy requirement is the average dietary energy intake predicted to maintain an energy balance in a healthy adult.

***-Energy balance*** occurs when calories consumed are equal to the energy expended.

***-Healthy adult*** should be of defined age, gender, and height & their weight and level of physical activity are consistent with good health.

*Some simple approximations can provide useful estimates*.

*examples:* *sedentary adults* require about ~30 Kcal/kg/day.

*very active adults* require ~ 40 kcal/kg/day

## Energy Content of Food:

-It is calculated from the ***heat released*** by the total consumption of food in a calorimeter.

-It is expressed ***in kilocalories*** (kcal, or Cal).

-The **standard conversion factors** for determining the metabolic caloric value of *fat*, *carbohydrates* and *proteins* are **9**, **4** and **4** Kcal/g respectively. F27.5

**How Energy is Used in the Body ?**

1- **Resting Metabolic Rate (RMR)**

It is the energy expended by an individual in a resting (basal), post-absorptive metabolic state.

It represents the energy required to carry out the normal body functions as respiration, blood flow, ion transport and maintenance of cellular integrity.

-In adults, ***RMR*** is about ~ *1800 Kcal for men 70 kg* & *1300 for women 50 kg*

**-50 – 70 %** of the daily energy expenditure in *sedentary individuals* is due to ***RMR***.

2- **Thermic Effect of Food** :(diet induced thermogenesis)

-It means, the production of heat by the body increases as much as 30% above the resting level during the digestion and absorption of food.

-This is called the thermic effect of food ***or*** diet-induced thermogenesis .

-Over 24 hour-periods, the thermic response to food intake may amount to about **5– 10 %** of the total energy used.

3- **Physical Activity**

-Muscular activity provides the *greatest variation* in energy expenditure.

-The amount of energy consumed depends on the duration and intensity of the exercise.

-In general, a *sedentary person* requires about 30 – 50 % more than the resting caloric requirements for energy balance, *whereas* a *highly active individual* may require 100% or more calories above RMR.
F27.6

**Acceptable Macronutrient Distribution Ranges (*AMDR*):**

**AMDR are defined as a range of intakes for a particular macronutrient that is associated with reduced risk of chronic disease while providing adequate amounts of essential nutrients .**

***AMDR for adults is***

**45 – 65 %** of their total calories from ***carbohydrates***.

**20 – 35 %** of their calories from ***fat.***

**10- 35 %** of their calories from ***protein***.

***AMDR* represents a balance designated to avoid risks associated with excess consumption of any particular macronutrient.**

Very high **FAT** diet can raise LDL cholesterol concentration and increases the risk of coronary heart disease (CHD).

-High **CARBOHYDRATE** diets are associated with a reduction of HDL cholesterol and an increase in triglycerides concentrations with increase risk of coronary heart disease (CHD).

**-PROTEIN** according to AMDR ensures an adequate supply of amino acids for tissue growth, maintenance and repair.

**BIOLOGIC PROPERTIES OF DIETARY MACRONUTRIENTS**

The incidence of a number of chronic diseases are significantly influenced by the kinds and amounts of nutrients consumed .For example,The role of the dietary fats and the risk of coronary heart diseases (CHD)

## Dietary Fats:

**Plasma Cholesterol & Coronary Heart Diseases (CHD)**

-Elevated levels of **total plasma cholesterol** result in increased risk for **coronary heart diseases** (**CHD**).

-The risk increases progressively with higher values for serum total cholesterol.

**Plasma Cholesterol:**

**-Total Plasma cholesterol** may arise from:

1) diet

2) endogenous synthesis.

-The level of **total plasma cholesterol** varies in response to **diet**.

**-Cholesterol** is transported in blood & between tissues in combination with proteins and phospholipids (lipoproteins especially **LDL** & **HDL**)

**LDL and HDL (lipoproteins) & CHD**

-The **risk of CHD** increases with elevated **LDL cholesterol**.

-High levels of **HDL-cholesterol** are associated with a decrease risk of **CHD**

These changes in lipoproteins are associated with other risk factors as smoking, obesity, sedentary lifestyle and others

-N.B. The risk of **CHD** increases with elevated levels of serum **triglycerides** (but with weaker association than LDL- cholesterol)

**Effects of lowering plasma cholesterol**

Treatment of hypercholesterolemia either by **diet control** or **antihyperchlosterlomic drug** is effective in:

**a)** decreasing **LDL**

**b)** increasing **HDL**

**c)** reducing risk of **CHD**

**Changes of lipoproteins (LDL & HDL cholesterol) due to:**

**-Diet control : 10 – 20 %**

**-Treatment by antiyperchlosterlomic drugs (as statin):30–40 %**

**Blood Lipid (plasma lipids, serum lipids)**

-Total Cholesterol (TC)

-HDL-cholesterol

-LDL-cholesterol

-Triglycerides (TG)

## Dietry Fats

**a-Triglycerids (triacylglycerols):**

-Saturated Fats

-Unsaturated Fats:

1-Monounsaturated Fats

2- Polyunstaurated Fats , n-6 fats, n-3 fats and Trans Fatty acids

**b-Diet cholesterol.**

**c-Plant sterols.**

# Dietary Fat and Blood Lipids

Triglycerides (**TGs**) are quantitavely the most important class of dietary fat.

The biologic properties of **TGs** are determined by the chemical nature of their fatty acids (**FAs**) as regards:

**1-** SATURATION : Presence **or** absence of double bonds in (saturated or unsaturated FAs) .

**2-** IF UNSATURATED FAs (double bonds).

- Number and location of double bonds in unsaturated FAs.

- Cis-trans configuration of the unsaturated FAs.

1- **SATURATED FAT**

They are **triglycerides** that contain ***FAs*** with ***no*** *double bonds*.

Main source of saturated fatty acids are

1- ***dairy*** and ***meat*** products

2- some ***vegetable oils*** (as coconut and palm oils)

Consumption of saturated fats is strongly associated with:

-high levels of **total plasma cholesterol.**

-high levels of **LDL** (**L**ow **D**ensity **L**ipoprotein ) cholesterol.

-high risk of **CHD (C**oronary **H**eart **D**iseases**) .**

**So, it is strongly advised to limit intake of saturated fat.**

2- **MONOUNSATURATED FATs**

They are **triglycerides** that contain ***FAs*** with ***one*** *double bond*

They are generally derived from ***vegetables*** and ***fish***.

Substitution of monosaturated FAs for saturated FAs results in:

1- Lowering of **total plasma cholesterol**

2- Lowering **LDL** cholesterol.

*3*- Increasing **HDL**

4- low risk of **CHD**

- This can explain (in part) the observation that the Mediterranean cultures with diet rich in **olive oil** (high in monounsaturated **oleic acid**) show a low incidence of **CHD**.

**The Mediterranean Diet;**

**Composition of typical Mediterranean dietary fat:**

**-rich in monounsaturated FAs (from olive oil)**

**-rich in n-3 fatty acids (from fish oils and some nuts),**

**-low in saturated fat**

-Generally, **Mediterranean diet** contains fresh food,

1- rich in **plant material**

2- **olive oil & fish oil** as the principal sources of fat

3- low amount of red meat

**Mediterranean diet is associated with:**

1-decreased serum total **cholesterol** & **LDL --- decrease risk of CHD**

(if compared with a typical western diet) **BUT**

2- little change of **HDL**

3- no change of **triglycerides**

3- **POLYUNSATURATED FATs**

They are **triglycerides** that contain ***FAs*** with ***more*** *than one double bond*.

The effect of **polyunsaturated FAs** on **CHD** is influenced by the *location of the double bonds* in FA

1- **n-6 fats**

2- **n-3 fats**

## n-6 fatty acids

also called **w 6 (omega 6)**

Long chain, polyunsaturated FAs with the first double bonds beginning at the **6th carbon**

(when counting from the methyl end of the fatty acid mol.)

*example:*

**Linoleic acid** (18: 2; D 9, 12; **n-6**, w 6)

- Essential FA
- Sources: from **vegetables: corn oil** , **sesame, cottonseed oil**

Nuts, soybeans, olive, avocado

## Biologic Effects of n-6 fatty acids

A**. Effect on plasm lipids & CHD**

1- Lowers **total plasma cholesterol**

2- Lowers **LDL**

3- **HDL** is also lowered (leading to decreasing its effect to decrease **CHD**).

B. **linolenic is an essential fatty acid.**

required for : 1- enters in membrane structure (fluidity)

2- synthesis of eicosanoids (20 carbon atoms FAs)

So, required in a range of **5 -10%** of total calories ( **no** more than 10% as oxidation of this FA is harmful)

## n-3 fatty acids

Long chain, polyunsaturated FAs with the first double bonds beginning at the **3rd carbon**

(when counting from the methyl end of the fatty acid molecule).

**Sources**:

1- **Plants** : **a-linolenic acid** (Essential FA)

2- **Fish oil**: **D**ocasa**H**exaenoic **A**cid (DHA)& **E**icosa**P**entaenoic **A**cid (EPA).

***SMASH*** (***S***almon, ***M***ackrel, ***A***nchovies, ***S***ardines, ***H***erring)

## Biologic effects of n-3 fatty acids

A.**Role in plasma lipids & CHD**

1- suppress **cardiac arrhythmia**

2- reduce plasma **triglycerides**

3- decrease tendency to **thrombosis** (Reduce risk of **CHD**)

4- ***little*** effect on **LDL** & **HDL**.

B. **alfa-linolenic acid** essential fatty acid (roles as in linoleic),required in range of **0.6 -1.2 %** of total calories

## The antithrombotic effect of n-3 fatty acids

Inhibition of conversion of *arachidonic acid (n-6 FA)* to *thromboxane A2* (TXA2) by platelets.

Instead, **n-3 fatty acids** are converted into **TXA3** (less platelet aggregation induction , i.e. less thrmbogenic).

**-Western diets** contain excess dietary **n-6 fatty acids** which competes with the formation of TXA3 derived from n-3 FAs. F27.12

## n-6 fatty acid Linoleic & n-3 fatty acid a-linolenic acid:(ESSENTIAL FATTY ACIDS)

-are **essential fatty acids**

- are required for : 1)the fluidity of membrane structure

2) synthesis of eicosanoids.

**Linoleic acid** (n-6 FA)

with an acceptable range **5 - 10%** of total calories (no more than 10% as their oxidation may lead to harmful products)

**a-linolenic** (n-3 FA)

with an acceptable range of **0.6- 1.2** % of total calories (higher values are recommended to protect against CHD)

## 4- TRANS FATTY ACIDS

They are chemically classified as *unsaturated* FAs. ***But*** behave more like *saturated* FAs.

**Biologic effect**

1- Elevate **LDL**

2- No effect on **HDL**

3- Increase risk of **CHD**.

**Sources:**

***-Not*** in plants

-present in ***ANIMALS*** in small amounts

***-BUT***: occur ***during the hydrogenation of vegetable liquid oils*** (manufacture of margarine). F27.13 , F2710.

5- **DIETARY CHOLESTEROL** :

-It is found only in **ANIMAL** products .

-The effect of dietary cholesterol on plasma cholesterol is **less important** than the amount and type of FAs.

6- **PLANT STEROLS:**

-Commercially available margarine containing hydrogenated plant sterols and steroid esters.

-They can reduce ***LDL* cholesterol** by inhibiting intestinal absorption of cholesterol from the intestine.

## Dietary Carbohydrates

**-CLASSIFICATION OF DIET CARBOHYDRATES**

a-Simple Sugars: Monosaccharides, Disaccharides.

b- Complex carbohydrates: Polysaccharides.

c- Fibe.

**A) Simple Sugars**

1- **MONOSACCHARIDES**

**Glucose & fructose: are the principal monosaccharides in food**

free **glucose & fructose**: available in fruits & bee honey

2- **DISACCHARIDES** :

**Sucrose** (glucose + fructose) : in **table sugar** & **molasses**

**Lactose** (glucose + galactose): in **milk**

**Maltose** (glucose + glucose) : i- produced by the enzymic digestion of polysaccharides

ii- present in **malt liquors**

**B) Complex Carbohydrates**

**POLYSACCHARIDES**

Complex carbohydrates are polysaccharides

They are polymers of glucose, which do not have a sweet taste.

**Starch**: is a complex carbohydrate that is found in abundance in **plants**: wheat & other grains, potatos, peas, beans & vegetables

C) **FIBER**

1-**Dietary fiber**:

- the nondigestible carbohydrates & is present in plants.

- provides little energy but has several beneficial effects

2-**Functional fiber**:

the isolated, extracted or synthetic fiber that has proven health benefits.

3-**Total fiber**: the sum of dietary fiber & functional fiber.

4-**Soluble fiber**:refers to fibers that form a viscous gel when mixed with a liquid.

5-**Insoluble fiber**: passes through the digestive tract largely intact.

**FUNCTIONS of DIATERY FIBER**

1- **Reduces constipation & hemorrhoids formation:** Fiber adds to the bulk of diet as it can adsorb 10-15 times, its own weight in water drawing fluid into the lumen of the intestine and increase bowl motility.

2- **Soluble fiber delays gastric emptying** : which can result in:

i- sensation of fullness.

ii- reduced peak of blood glucose following a meal.

3- **Soluble fiber lower plasma LDL cholesterol (with reducing risk of CHD)**

By decreasing absorption of cholesterol & other fats,

So, it increases fecal loss of cholesterol& interfering with bile acid reabsorption . F27.16

**Recommended daily intake of fiber** (AI)

25 grams for women ,38 grams for men about 40 grams /day.

Amount of fiber in our diet has to be increased than currently consumed (for example: American diets contains only ~ 11 grams/day)

**Dietary Carbohydrates & Blood Glucose** :Some carbohydrate-containing foods produce a rapid rise followed by a steep fall in blood glucose concentration, *whereas others* result in gradual rise followed by a slow decline.

**The Glycemic Index**

Is defined as the area under the blood glucose curves seen after ingestion of meal with carbohydrate-rich food, compared with the area under the blood glucose curve after a meal consisting of the same amount of carbohydrates in the form of glucose or white bread. F27.17

**Food with low glycemic index** tends to:

1-create sense of satiety over a longer period of time

2-& may help to limit caloric intake

**Requirements for Carbohydrates**

Carbohydrates are **not essential** nutrients, because the carbon skeletons of amino acids can be converted into glucose. **However,** the absence of dietary carbohydrate leads to degradation of body proteins whose constituent amino acids provide the carbon skeleton for gluconeogenesis.

## RDA for Carbohydrate:

-Is set at **130 g/day** for adults and children based on the amount of glucose used by carbohydrate dependent tissues (as brain & RBCs).

-However, this level of intake is usually exceeded to meet

energy needs.

-Adults should consume **45 – 65 % of their total calories from carbohydrates**.

**-Added sugar should not represent more than 25% of total energy** as sugar may displace nutrient-rich foods from the diet, potentially leading to deficiencies of certain micronutrients (as vitamins & minerals)

## Simple Sugars & Diseases:

-Diets high in sucrose do **not lead to diabetes** or hypoglycemia.

-Carbohydrates are **not inherently fattening** as they yield 4 Kcal/g (same as proteins & less than half of that of fats) **BUT**, carbohydrates result in fat synthesis **only** when consumed in excess of body needs of energy.

-Excess sucrose ingestion may increase risk of **dental caries**.

## Dietary Protein:

**-**the protein in food provides **essential amino acid**.

**-10** of the 20 amino acids needed for the synthesis of body proteins are **essential**. i.e. can not be synthesized in humans at an adequate rate

**-8** of these 10 are **essential at all times**.

**-Argenine** and **histidine** are required during periods of rapid tissue growth as in childhood and recovery from illness.

## Quality of Proteins:

The quality of dietary protein is a measure of its ability to provide the essential amino acids required for tissue maintenance.

The protein quality is evaluated by the following standard:

**P**rotein **D**igestibility **C**orrected **A**mino **A**cid **S**coring (***PDCAAS***)

-which is based on :1) the profile of **essential amino acids**

2) the **digestibility** of the protein

-The highest possible score is **1.00 . F27.18**

## SOURCES OF DIEATRY PROTEINS:

1- **ANIMAL SOURCES PROTEINS:**

-with a **high quality** as they contain all essential amino acids in proportions similar to those required for synthesis of human tissue proteins. (except for gelatin prepared from animal collagen which is of low biological value as a result of deficiencies in several essential amino acids).

2- **PLANT SOURCES PROTEINS**

-Proteins from wheat, corn, rice & beans

-with a **lower quality** than of animal proteins.

-Proteins from different plant sources may be combined in a way that the result is equivalent in nutritional value to animal proteins.

-Wheat (lysine-deficient but, methionine-rich) is combined with kidney beans (methionine-poor but lysine-rich), to produce a complete protein of improved biologic value.

## NITROGEN BALANCE :

Nitrogen balance occurs when the amount of nitrogen **consumed**equals that of the nitrogen **excreted** in urine, sweat and faeces.

1- **Positive nitrogen balance:**

nitrogen intake exceeds nitrogen excretion (loss). occurs in situations in which tissue growth occurs as in children, pregnancy or during recovery from an emaciating illness.

2- **Negative nitrogen balance:**

nitrogen loss is exceeds nitrogen intake occurs with inadequate dietary protein, lack of essential amino acids, or during physiologic stresses as trauma, burns, illness or surgery.

## REQUIREMENTS FOR PROTEIN IN HUMANS:

-The greater the proportion of animal protein included in the diet, the less the protein is required.

-RDA for protein is computed for proteins of mixed biological value at **0.8 g/kg of body weight** for adults or about 56 g of proteins for 70 kg individual.

-People who **exercise** on a regular basis may benefit fromthe extra protein to maintain muscle mass.

(1g/kg has been recommended for athletes)

**-Pregnant** & **lactating** women require up to 30 g/day in addition to their basal requirements.

**-Children** should consume 2 g/kg/day to support growth.

## CONSUMPTION OF EXCESS PROTEIN:

-There are **no physiologic advantages** to the consumption of more protein than the RDA.

-Proteins consumed in excess of the body's needs is deaminated and the resulting carbon skeleton metabolized to provide: 1- energy , *or* 2- acetyl CoA for fatty acid synthesis

## THE PROTEIN SPARING EFFECT OF CARBOHYDRATES:

-When the intake of the carbohydrates is **low**, amino acids are deaminated to provide carbon skeleton for the synthesis of glucose that is needed for energy production especially to Brain (gluconeogenesis).

-If carbohydrates intake is **less than 130 g/day**, a great amount of proteins are metabolized to provide precursors of gluconeogenesis (protein loss), Therefore, carbohydrate is considered to be **protein-sparing**, as it allows amino acids to be used for repair and maintenance of tissue protein instead of being used for gluconeogenesis.

## PROTEIN-CALORIE MALNUTRITION:

1-**Related to a nutritional status**: (common in poor countries), inadequate intake of protein and/or energy.

2-**Related to a medical condition**: (common in developed countries), Chronic Illness , Major Trauma, Severe Infection, Major Surgery

-Affected individuals show a variety of symptoms, including:

1-Depressed immune system with a reduced ability to resist infection.

2- Death due to a secondary infection is common.

Two extreme forms of malnutrition are observed: **KWASHIORKOR , MARASMUS**

1- **KWASHIORKOR:**

-Kwashirkor occurs when **protein** deprivation is relatively greater than the reduction in total calories.

-Frequent in children after weaning at about one year of age, when their diet consists predominantly of carbohydrates.

-Typical symptoms include:

A-**decreased plasma albumin concentrationedema .**

**B-**stunted growth.

C-skin lesions.

D- depigmentated hair.

E-anorexia.

F-enlarged fatty liver.

2- **MARASMUS** :

-Marasmus occurs when **calorie** deprivation is relatively greater than the reduction of protein.

-Marasmus usually occurs in children younger than one year of age when the mother's breast milk is supplemented with native cereals which are usually deficient in protein and calories.

-Typical symptoms include:

A-arrested growth.

B-extreme muscular wasting

C-weakness and anemia.

-**No edema or changes in plasma proteins (albumin).**

**DIET & CANCER**

-Cancer esophagus, stomach, large bowl, breast, lung and prostate are influenced by nutritional factors.

-High intake of saturated fats are associated with increased risk of certain cancers especially cancer colon, prostate, and breast.

-In general, populations consuming diets rich in fruits and vegetables have lower incidence of many kinds of cancer. High fiber diets are associated with a lower risk of cancer colon.