Biochemistry Team 435

جامعة الملك سعود
King Saud University 1957

NUTRITIONAL REQUIREMENTS

* Please check out this link to know if there are any changes or additions.

Color index: Important | Doctors notes | Further explanation.

OBJECTIVES:

- Understand the basic terms of nutritional requirements that are important for establishing intake of a nutrient in a population.
- Understand the food pyramid that recommends daily serving size from each food group for vegetarians and non-vegetarians.
- Identify dietary guidelines and goals that are necessary for good health n Discuss energy requirement in humans including basic energy expenditure and the factors that affect it.
- Know about total parenteral nutrition (TPN) and its applications

What is nutrition?

Composition and quantity of food intake by living organisms

Composition = what we need?
Quantity = how much do we need?

Biochemical utilization of food

Food should be digested and utilized by enzymes to extract the nutrition

Human nutrition is divided into three areas

- Undernutrition (nutrient deficiency)
- Overnutrition (excessive nutrient intake)
- Optimal nutrition (balanced nutrient intake)

The amount of nutrition you take in is exactly the amount you require

Assessments of malnutrition

A person's nutritional needs differ in different stages of life (pregnant women and growing children require more nutrition)

Dietary intake studies	Identify people with deficient diets. "see next slide for further explanation" "survey-based / asking the population what they ate in the last 24 hours"
Biochemical studies	Identify subclinical nutritional deficiencies. by blood tests, when it's hard to obtain information from people". . "see next slide for further explanation""
Clinical symptoms	identify clinical nutritional deficiencies

Subclinical deficiencies: when blood shows nutritional deficiency but without symptoms

DR SUMBUL'S EXPLANATION:

Dietary intake studies = based on surveys

- **What type of survey?**
  - 24 hour RECALL SURVEY -in order to identify the nutritional needs of a specific population ,you must specify the age and gender of the population. You must also choose healthy individuals without chronic illnesses.
  - In a 24 recall survey you ask the individuals to recall what they ate in the last 24 hours Then based on the information you obtained ,you calculate how much carbs, proteins ,fats , vitamins , ... they are taking .
  - This is used to identify the people who have deficient diets The negative aspects drawback of this survey :It tends to overestimate people who are malnutrition This study also helps in identifying people who are at higher risk of developing malnutrition ,so that intervention takes place! (the intervention is our goal)

- **In biochemical studies:**
  - identify the population ,with Healthy individuals(with no apparent symptoms) Then you need to have whatever nutrient you are concerned about with a proper biochemical assay.
  - you must know the normal levels in the biochemical assays in order to identify the people with slightly raised or decreased levels.
- **What is our goal in these biochemical studies?** To intervene before any clinical symptoms appear
- biochemical studies are MORE accurate than dietary intake studies!!!!!

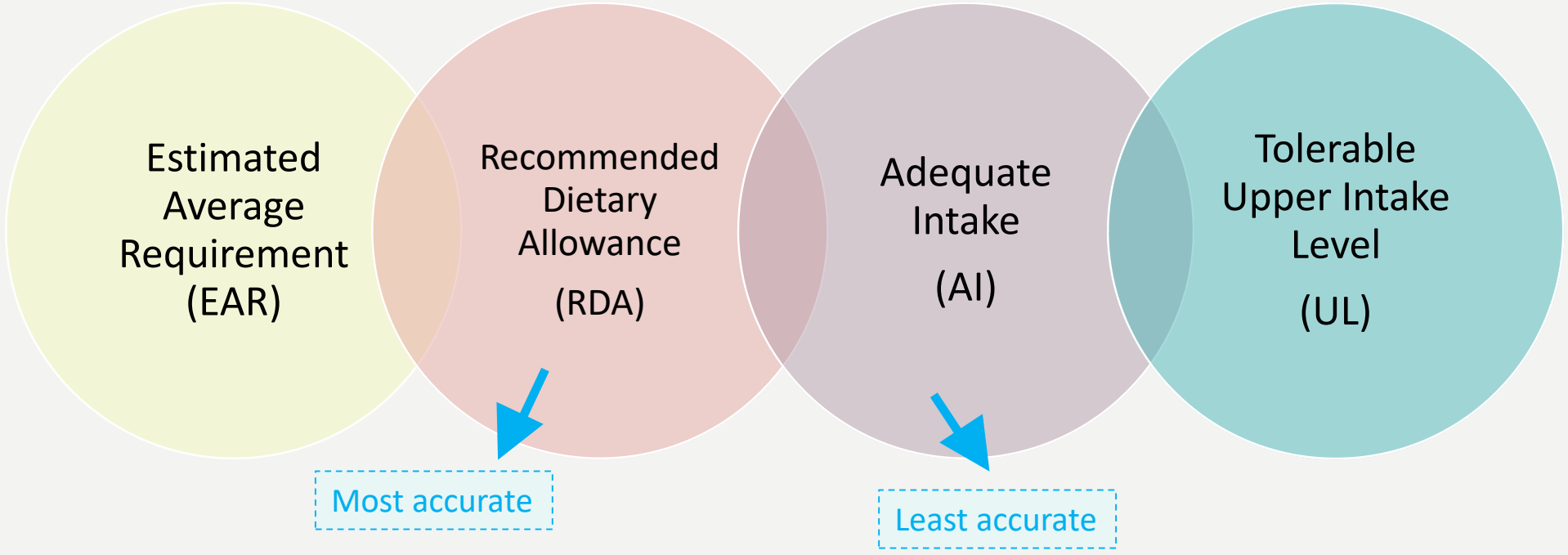
Dietary Reference Intakes (DRIs)

- **What is it? Quantitative** estimates of nutrient intakes required to prevent deficiencies and maintain optimal health in populations. So, it is how much do you need in "numbers" to keep healthy.
- **Recommended by:**

Food and Nutrition Board of the National Research Council, USA (also called the national academy of sciences)

A population is any group of people with at least one characteristic in common
Example: vegan middle aged men

Dietary reference intakes have four standards:



Dietary reference intakes have four standards:

السلايده مهمة جدا وضروري يجي منها سؤال!

Estimated Average Requirement (EAR)

ايز = اذن = ما اسمعك زين!
اسمع بس 50%

- The amount of nutrient intake estimated (calculated) to meet the nutritional requirement of half of the healthy individuals **(50%)** in an age and gender group.
- In an age and gender population, how much of nutrient is required so that at least 50% of the population will be healthy "won't develop any deficiency".

Recommended Dietary Allowance (RDA)

رضى، مانيب راضية عليك
%100، رضاي عليك 98%

- The amount of nutrient intake that is sufficient to meet the nutritional requirement of nearly all **(97-98%)** healthy individuals in a group. So there is 2-3% of the population that will not receive the sufficient amount of the nutrient if they take the recommended daily allowance
- RDA is two standard deviation (SD) above Estimated Average Requirement (EAR) . SD is the variance from person to person.
- **RDA = EAR + 2 SD** ."see next slide"

Adequate Intake (AI)

It is used instead of EAR and RDA if:

- A nutrient is considered essential but the experimental data are **inadequate** for determining EAR and RDA.
- It covers the nutritional requirement of **all** individuals in a group with approximation due to insufficient data.

Tolerable Upper Intake Level (UL)

- The **highest level** of daily nutrient intake that has **no** adverse health effects or **toxicity** in almost all individuals.
- As intake increases above the UL, the potential risk of adverse effects may increase. The UL is not intended to be a recommended level of intake. The UL are useful because of the increased availability of fortified foods and the increased use of dietary supplements.

Extra explanation

Example of EAR :

- the population is 100 girls from 20-25 (healthy) → collect the data for at least 50 girls → calculate the amount of vitamin X required for each of these healthy girls to remain healthy without any deficiency in vitamin x .

So in these 100 girls ,50 are fine with 250 grams of the vitamin ,but some require 280, others 160 ....so individuals vary in their nutritional needs depending upon their body and activities **.So what we is take the EAR value so that at least we protect 50% of the population(if they take the 250 grams).**

Example of calculating RDA:

- **Calculate the RDA by using the following data:**
  - EAR =190 .
  - Upper limit acquired from data= 220 .
  - Lower limit= 160 .
- **What is the SD in this case?** 30 .
  - 190 - 160 =30 And 220- 190 = 30.
  - So RDA= 190 + (2* 30) =250.
  - Note that the RDA is higher than the calculated upper limit! So we will cover the requirement of 97-98% but it will not cause toxicity. (RDA is still safe because the value of toxicity is much higher)

Dietary Reference Intakes (DRIs)

As you increase the nutrient intake past the Upper limit of intake , the probability of developing symptoms of toxicity increases.

- If there was an **adequate data** then we can calculate the **EAR**.

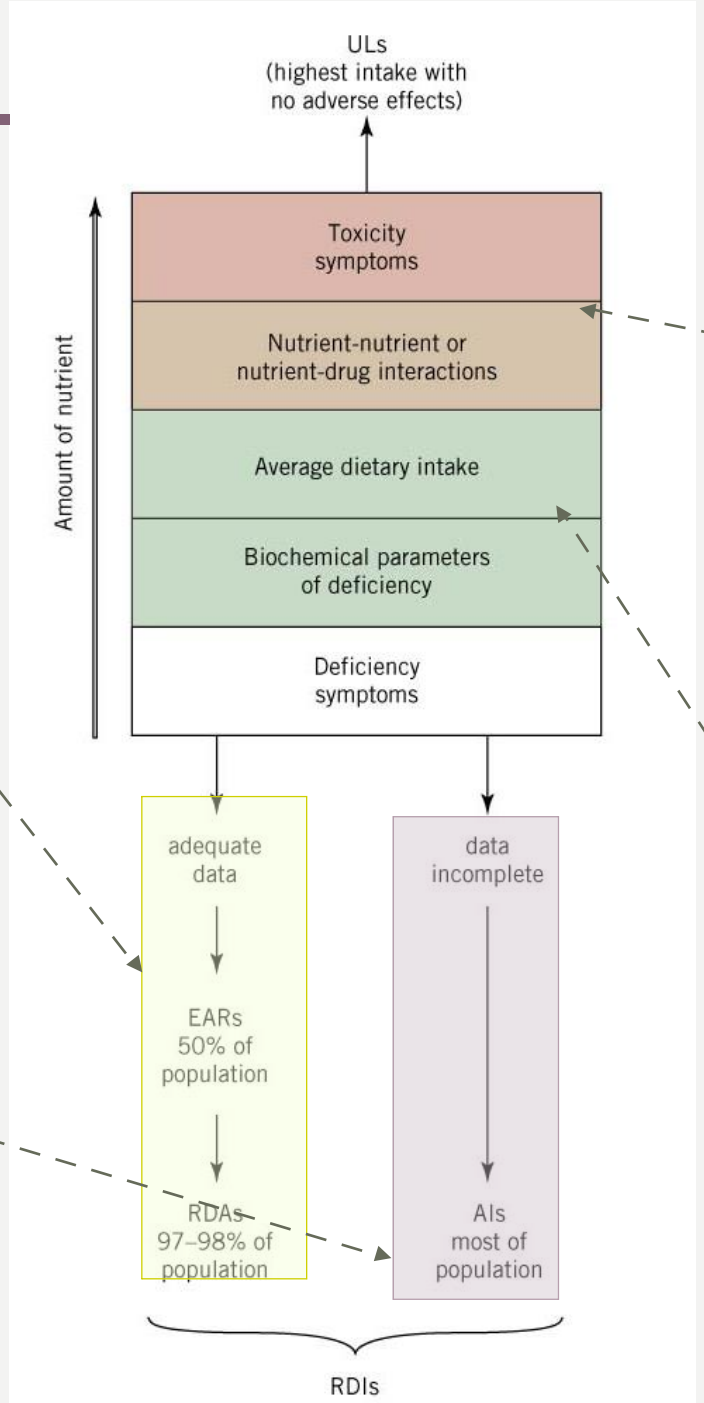
"it is safe for at least **50%** of the population"

- On the **basis of EAR** we can calculate the **RDA**

"it is safe for **97 – 98 %** of the population".

- If the data was **inadequate**, give the **AI**

"it is safe for almost all of the population".



- <u>If the amount of nutrients intake were above the average dietary intake:</u>
  - Nutrient-nutrient or nutrient-drug interaction
  - if it was much higher → toxicity symptoms "it exceeds UL"

<u>In the middle there is the average dietary intake</u>

- <u>If the amount of nutrients intake were **below** the average dietary intake:</u>
  - Biochemical parameters of deficiency "**subclinical**" .
  - If it was much lower → deficiency symptoms "**clinical**".

Acceptable Macronutrient Distribution Ranges (AMDR)

It is a range of **adequate** intake of a **macronutrient** associated with reduced risk of chronic diseases while providing adequate amounts of essential nutrients.

AMDR for adults (% of total calories)	
Carbohydrates	45 – 65 %
Fats	20 – 35 %
Proteins	10 – 35 %
Fibers	> 25 g

Macronutrients have ranges instead of fixed values because their requirement differ from one person to another , depending upon activity , metabolism , and needs
Note that fiber does not provide us with energy.
What are the functions of fiber? Helps in the digestion process and lowers blood cholesterol
Diets within these ranges are acceptable ,but diets that are outside these ranges such as the Atkins diet, will cause problems related to the excessive consumption of fats.
The Atkins diet is a high fat low carb diet (fat intake is past 35%).

Macronutrient:
- Nutrients we need in a large amount
- carbohydrates / fats / proteins / fibers
- It provides energy
- They are the building blocks for growth and development

Micronutrient:
- Nutrients we need in a small amount
- Minerals and vitamins
- They don't provide any calorie
- They are involved in the metabolic reactions "coenzymes"

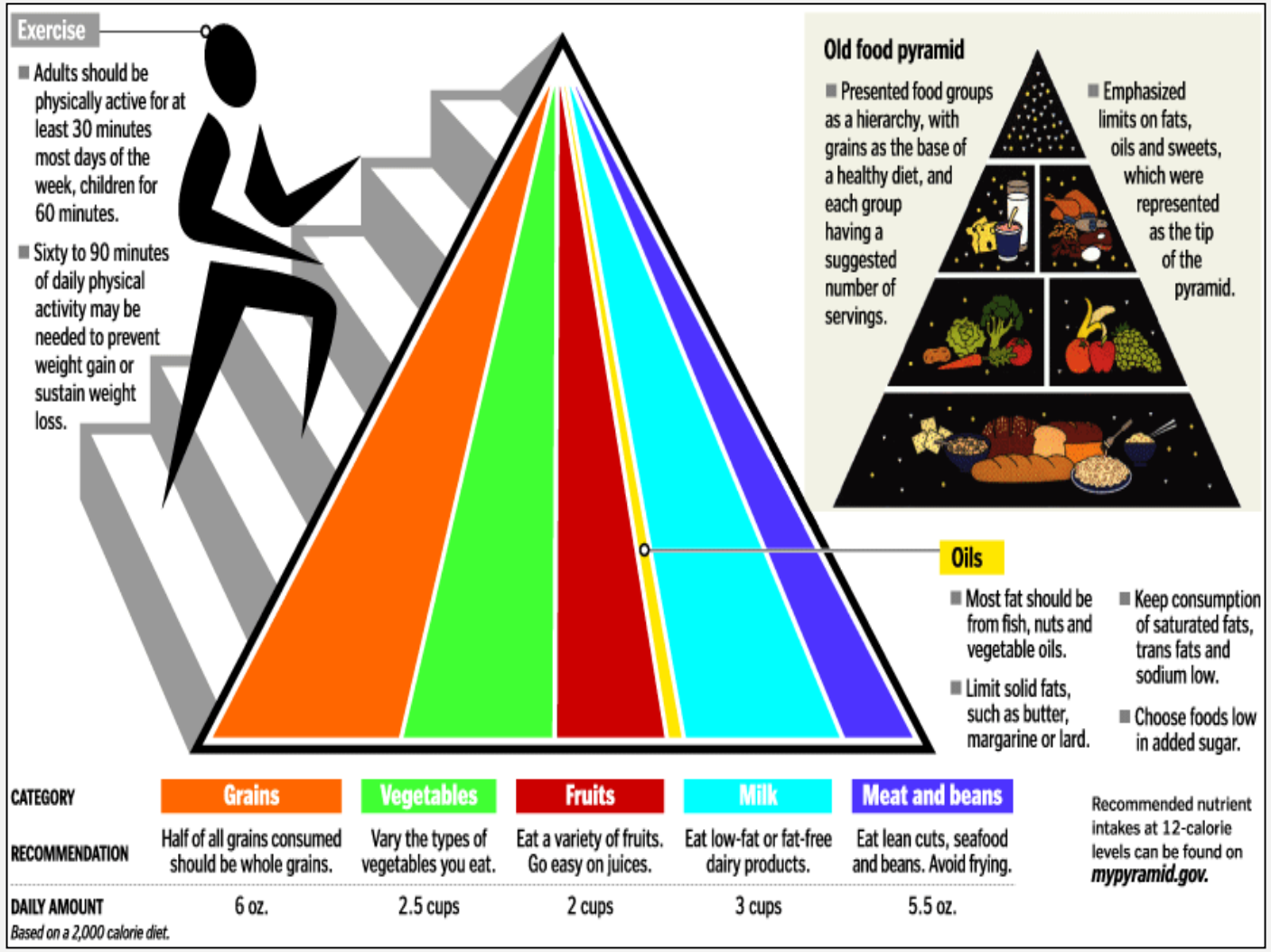
Food pyramid

- Public educational tool established in 1992
- Recommends size of daily servings
- **Pyramid** shape
- **Fats**, **oils** and **sweets** have small serving size

Old pyramid "2 Dimension"
- At the bottom → grains & cereals
- above it → fruits & veggies
- Above it → meats & dietary products
- On the top → sweets, fats & oils

New pyramid "3 Dimension"
- Exercise is added

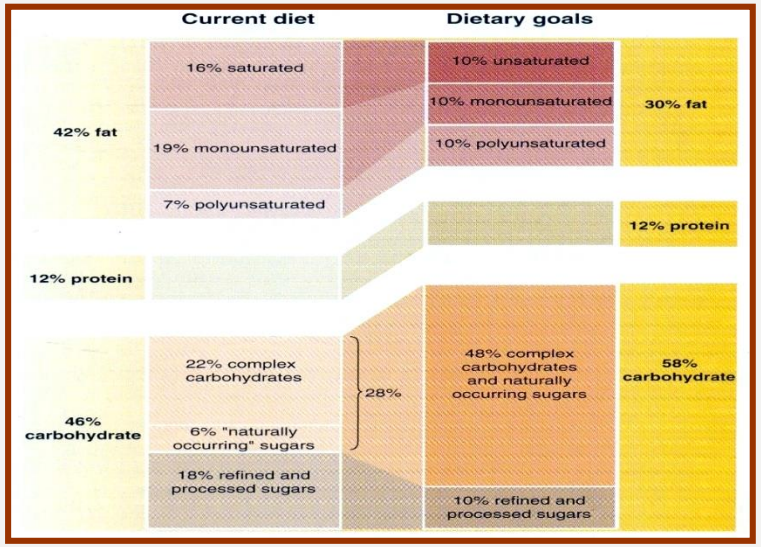
Exercise has been added with the following guidelines:
Adults should be physically active for at least 30 minutes most days of the week. Children for 60 minutes 60 to ninety to prevent weight gain or sustain weight loss.



-Saturated fat should be less than unsaturated

Dietary guidelines and goals

1. Consume a **variety of foods** from the basic food groups.
2. **Control calorie** intake to manage body weight.
3. Be physically **active** everyday.
4. Choose **fats** and **CHOs** wisely for good health.
5. **Increase** daily intake of fruits, vegetables, whole grains, and non-fat or low-fat milk and milk products
6. Choose and prepare foods with **little salt.**
7. People should get their nutrients **not** from supplements but **from food** to avoid excess toxicity.



This picture is a study that compares the diet of Americans to the dietary goals. They are eating 'bad carbohydrates', simple carbs gives quick energy and can be stored in fat.

Goal of the study:
Reduce the amount of fat but increase the carbs Reduce saturated fats but increase the unsaturated fats These changes must be sustained throughout life

Energy requirement in humans (rough estimate)

- The dietary energy intake required to maintain energy balance in a healthy individual.
- **Energy balance is maintained by**: **calorie intake** and **energy expenditure** (use or burning).
- **Energy content of food is measured in:** calories or kilocalories (heat energy).

Note: Vitamins help in energy processes but don't give energy.

Sex	Age	Weight (Kg)	Avg. Energy Needs (kcal)
Men	23–50	70	Up to 2900
Women	23–50	55	Up to 2200
Pregnant	-	-	+300
Lactating	-	-	+500

Naturally, the appetite of pregnant women is increased

Vegetarians

Nutrient intake:

Lower intake of iron, calcium and vitamin D (no consumption of meat or milk)

Long-term vegans may develop **megaloblastic anemia** due to vitamin **B12** deficiency

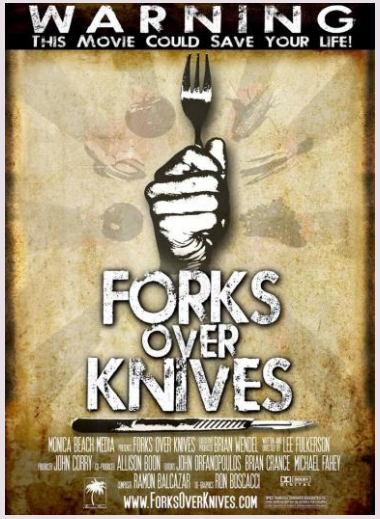
Most consume **enough protein**

Lower in total **dietary fat**

For example; beans and mushrooms are good sources of protein

Vegetarians and chronic disease:

Lower Body Mass Index (BMI).	**Lower** death rate from ischemic heart disease.	**Lower** blood pressure.	**Lower** cancer rates compared to non-vegetarians.



Speaking of vegan diets, I highly recommend this documentary

Researchers here explore the possibility that people changing their diets from animal-based to plant-based can help eliminate or control diseases like cancer and diabetes.

Click here to check out the documentary's trailer . (2:08)

Basic energy expenditure depends on

Resting metabolic rate (RMR)

- Energy expense at **rest**.
- **Required for:** normal body function.
- **Depends on:** age, sex, growth, body surface area, fever, fasting, stress
- **Men:** 1800 kcal.
- **Women:** 1300 kcal.

RMR is the energy used or consumed by the body at rest. This energy is consumed by normal functions.

Physical activity

- **Sedentary person: 30-50%** above RMR (very light activity -normal activity- e.g. walking to the car or going to school ..etc.
- **Active person: 100%+** above RMR
- Physical activity is variable. it has the strongest effect.

So this energy will be used for respiration ,and to maintain electrolyte balance and blood flow

Thermic effect of food

- Heat produced by the body due to food digestion and absorption.(heat rises may rise up to 30% when the body is metabolizing food)
- **5-10%** of total energy expenditure.

Physical activity is the Variable that introduces the maximum variation in energy requirement

Total Parenteral Nutrition (TPN)

I.V nutrient

Tube feeding

❖ **What is it?**

A type of exogenous nutrition in which terminally-ill patients are provided with all essential nutrients **intravenously** or through **tube feeding.**

❖ **TPN is particularly indicated in:** severe inflammatory bowel disease ,or in severe ulcers like ulcerative colitis, **coma**, **cachexia, prolonged ileus (loss of intestinal motility)** and **extensive burns**.

❖ Tube feeding is only provided to patients whose **GI tract is intact** and supports this type of nutrition (**Dr sumbul said that tube feeding is actually enteral nutrition instead of a TPN)**

❖ Nutrients are pumped into a **large central vein** to allow rapid dilution of the solution **(3 L / 24 hr).**

cachexia : is loss of appetite due to disease, while anorexia nervosa is loss of appetite either psychologically or any other reasons not related to a disease

Standard composition of TPN feed (24 hr requirement)	
Energy content	2000 kcal
Nitrogen	12–14 g
Fat	900 kcal
Glucose	1000 kcal
Electrolytes, trace elements, vitamins:	present
Volume	3 liters

❖ Individual nutritional requirements of patients may **vary** (must be assessed to know their requirements)

❖ Continuous biochemical, hematological and immunological **monitoring of patient** on TPN is required (initially every six hours until patient's glucose is stable, after this occurs monitoring is no longer done in this frequency)

❖ You must monitor the patient's liver function test and the glucose levels because the patient ma develop hyper or hypoglycemia then you must change the TPN contents ,the glucose and insulin levels must also be changes

Check your understanding!

Q1: in order to assist the malnutrition clinically we need to measure the nutritional deficiencies through:

A. Dietary intake studies.
B. Biochemical studies.
C. Clinical symptoms.
D. both A+B.

Q2: Estimated average requirement is the amount of nutrient intake estimated to meet the nutritional requirement of:

A. 1/2 of the healthy individuals in both genders.
B. 1/2 of the healthy individuals in the same gender group.
C. 1/2 of the sick individuals in the same gender group.
D. non of the above.

Q3: : the Recommended Dietary Allowance is :

A. above the Estimated Average Requirement by double of the standard deviation.
B. above the Adequate Intake by one standard deviation.
C. below the Estimated Average Requirement.
D. un-known value.

Q4: : by using the Adequate Intake standard in a group which of the following facts will be true:

A. the nutritional requirement will cover approximately 98% of the individuals.
B. the nutritional requirement will cover approximately 50% of the individuals.
C. the nutritional requirement will cause toxicity in the 100% of the individuals.
D. the nutritional requirement will cover approximately 100% of the individuals.

Q5: : the Tolerable Upper Intake Level:

A. should not cause toxicity.
B. could have some adverse health effects.
C. dangerous level that we should avoid.
D. B+C.

1.C 2.B 3.A 4.D 5.A

Check your understanding!

Q6: : the Range of total calories of Carbohydrates that is associated with reduced risk of chronic diseases is example of which of the following standards:

A. Adequate Intake.
B. Acceptable Macronutrient Distribution Ranges.
C. Recommended Dietary Allowance.
D. Dietary Reference Intakes.

Q7: : in the Food Pyramid which of the following food has small serving size:

A. fats and oil.
B. proteins.
C. sweets.
D. both A+C.

Q8: : Vegetarians may develop megaloblastic anemia due to:

A. vitamin D deficiency.
B. iron deficiency.
C. vitamin B12 deficiency.
D. vitamin B1 deficiency.

Q9: : women need: 1300 kcal & Men need: 1800 kcal for :

A. Resting metabolic rate.
B. Energy expense at rest.
C. Energy required for normal body function.
D. all of the above.

Q10: : the Basic energy expenditure depends on:

A. Heat produced by the body due to food digestion and absorption.
B. Energy expense at rest.
C. the physical activity of the person.
D. all of the above.

Q11: : depending on the Total Parenteral Nutrition the patient with intact GIT exogenous nutrition provided for them through tube feeding.

A. true.
B. false.

6.B 7.D 8.C 9.D 10.D 11.A

Done by:

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Resources:

- 435's slides and notes.
- Lippincott's illustrated reviews: Biochemistry – sixth edition.

Look at your track record : You have survived 100% of everything in your life so far so there is very high chance you are going to survive anything that's to come.

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