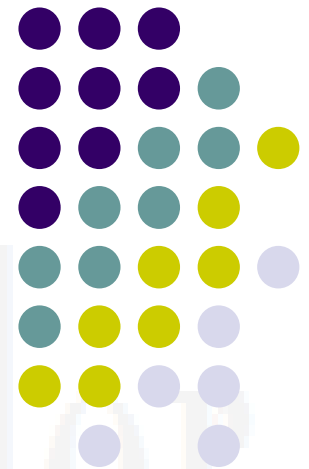




Nutrition

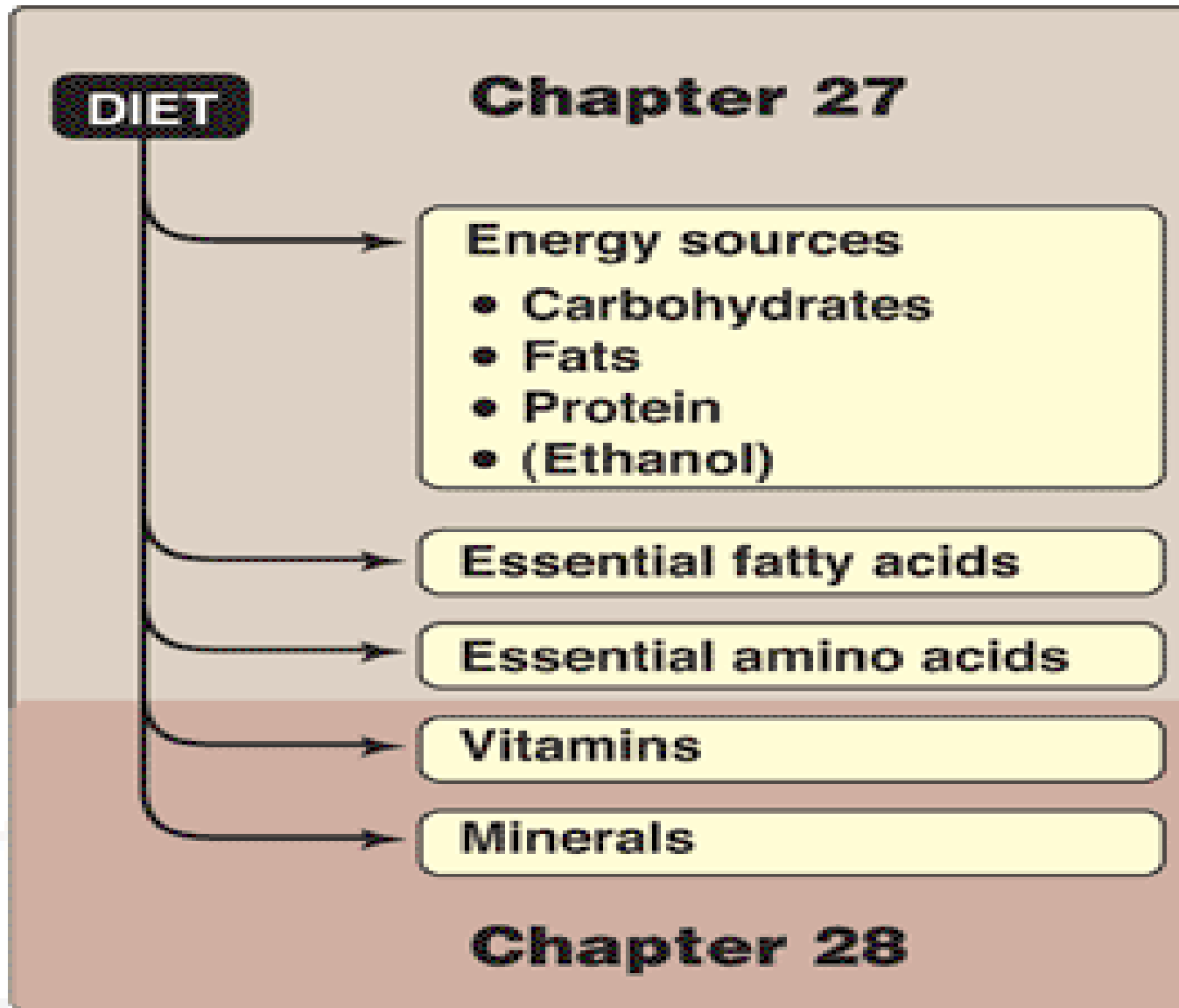
DR PIYUSH TAILOR
Associate Professor
Dept of Biochemistry
Govt. Medical College
Surat





- Nutrient – a substance that promotes normal growth, maintenance, and repair
- **Macro-nutrients** – carbohydrates, lipids, and proteins
- **Micro-nutrients** – vitamins and minerals (and technically speaking, water)
- It prevent human being from chronic disease.

Essential nutrients obtained from the diet.



Ethanol is not an essential component of the diet but may provide a significant contribution to the daily caloric intake of some individuals.

DRIs

```
graph LR; DRI[DRI's] --> EAR[Estimated Average Requirement (EAR)]; DRI --> RDA[Recommended Dietary Allowance (RDA)]; DRI --> AI[Adequate Intake (AI)]; DRI --> UL[Tolerable Upper Intake Level (UL)];
```

Estimated Average Requirement (EAR)

Recommended Dietary Allowance (RDA)

Adequate Intake (AI)

Tolerable Upper Intake Level (UL)

Dietary Reference Intakes (DRIs)



- Nutrients required to prevent deficiencies and maintain optimal health and growth.
 1. Estimated Average Requirement
 2. Recommended Daily Allowance
 3. Adequate Intake
 4. Tolerable Upper Intake Level

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Estimated Average Requirement



- Requirement of one half of the healthy individuals
- To specific age and gender group.
- It is useful in estimating the actual requirements in groups and individuals.

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Recommended Daily Allowance



- Requirements of nearly all (97–98%) the individuals and gender group.
- to provide a margin of safety for most individuals.
- The EAR serves as the foundation for setting the RDA.

$$RDA = EAR + 2SD_{EAR}$$



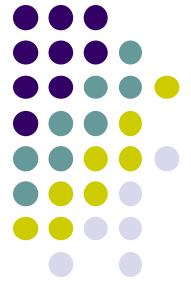
Adequate Intake

- It is set when scientific evidence is not available for EAR or RDA.
- Based on estimates of nutrient intake by a group (or groups) of apparently healthy people

Example,

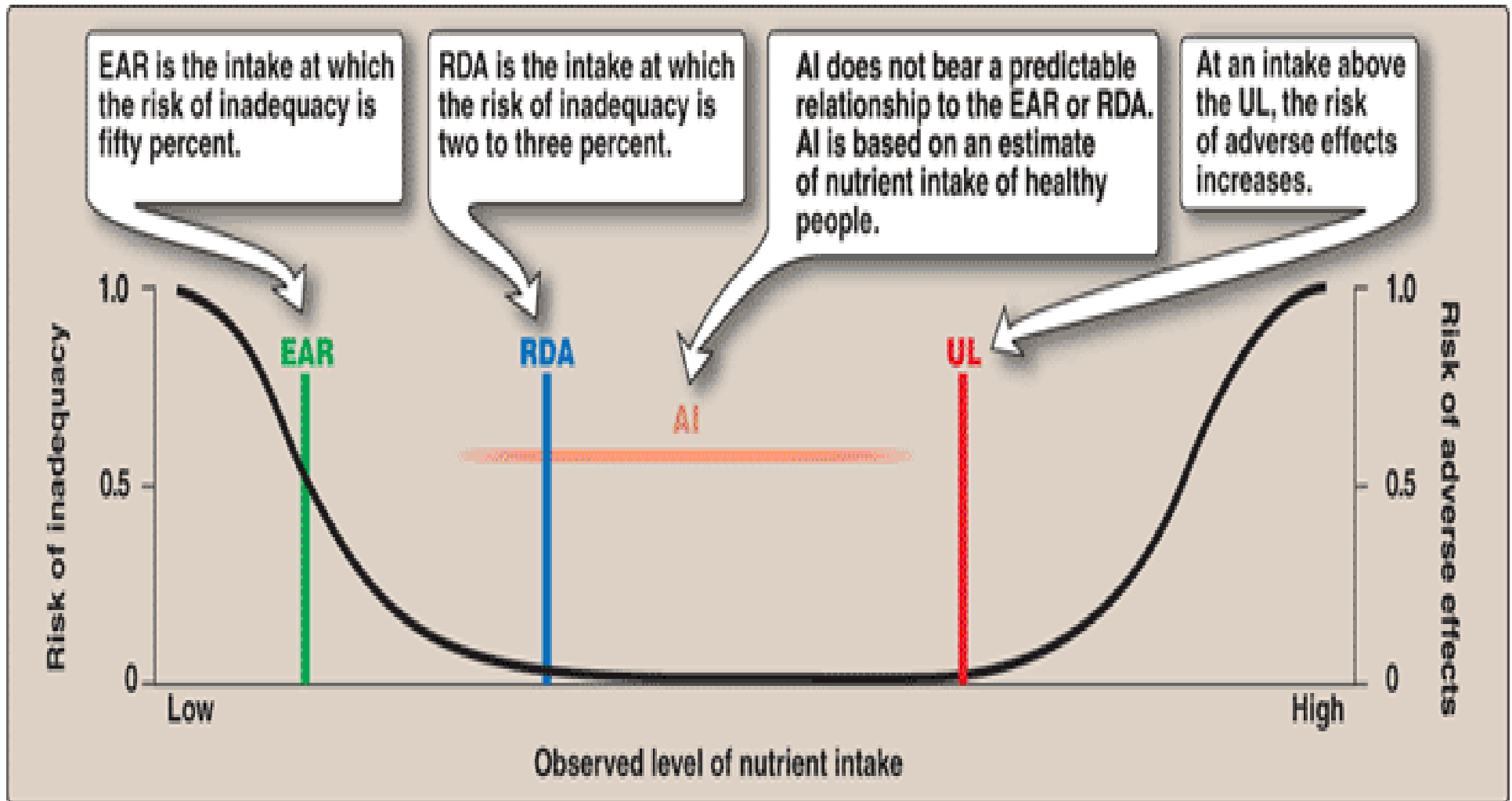
- AI for infants,
- “Human milk is source of food for the first four to six months”

Tolerable Upper Intake Level



- Highest average daily nutrient intake level to almost all individuals in the general population.
- As intake increases above the UL, the potential risk of adverse effects.
- Useful because of
 - Availability of fortified foods
 - increased use of dietary supplements.

Comparison of the components of the Dietary Reference Intakes



Energy Requirement



- Energy Requirement in a healthy adult accordingly
 - Age
 - Gender
 - Level of physical activity.
 - Differences in the genetics.
 - Body composition
 - Metabolism
 - Behavior of individuals

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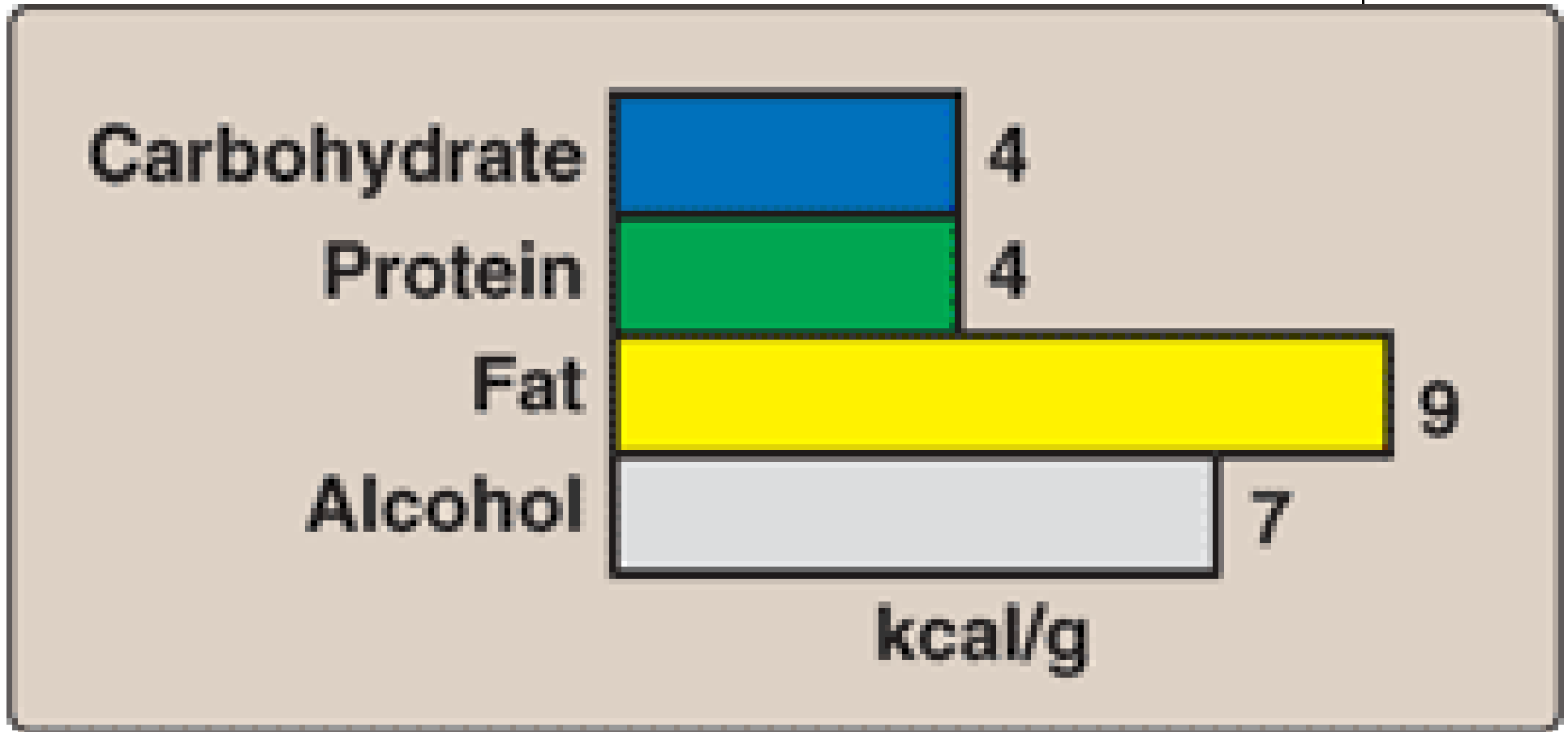
Energy Requirement in kcal/kg/day



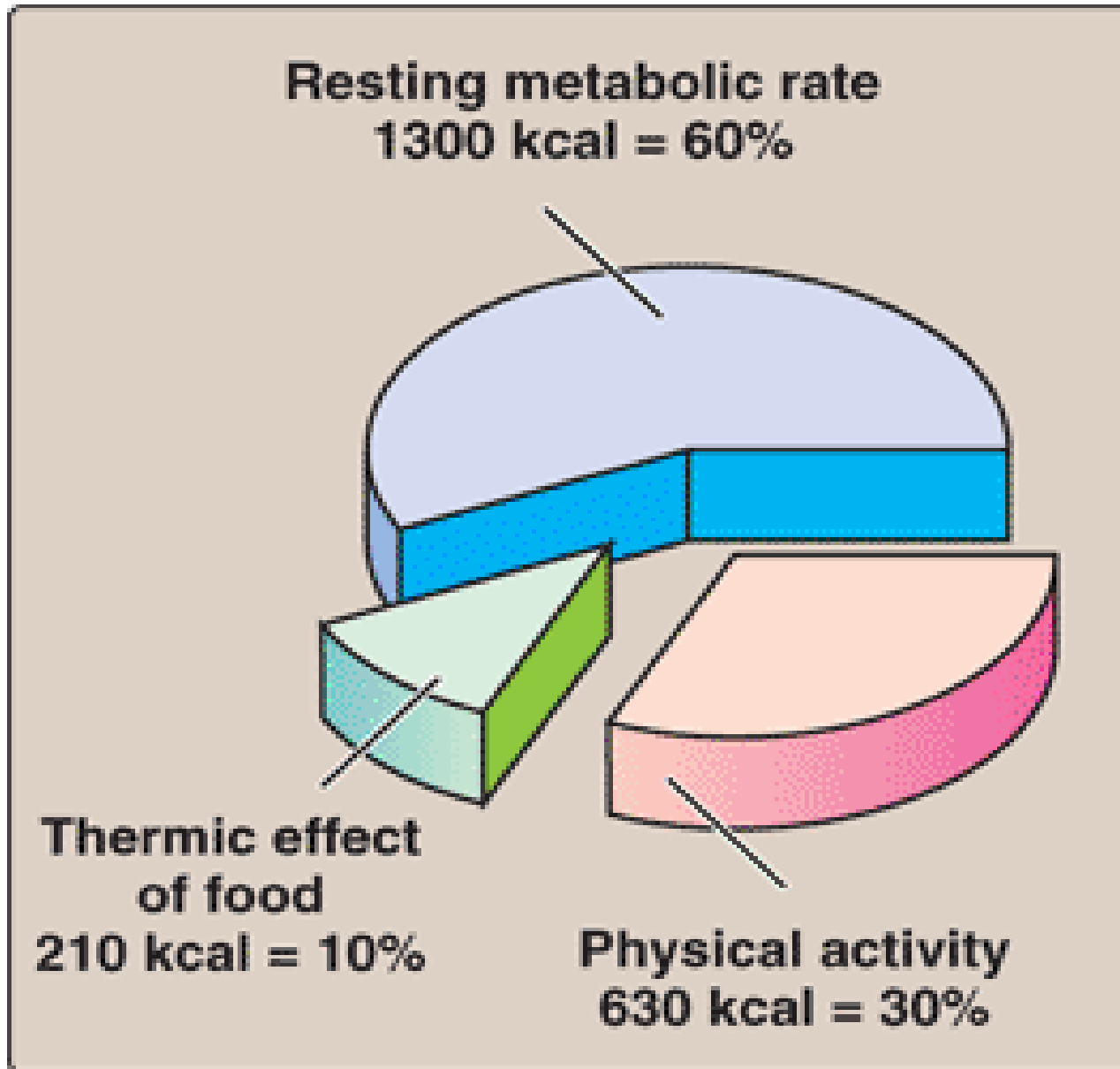
- - Sedentary adults = 30
 - Moderately active adults = 35
 - Very active adults = 40
- 1 kcal(cal) = 4.128 Joules.

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Average energy available from the major food components



How energy is used in the body



Total energy expenditure in a 20-year-old woman, 5 feet, 4 inches tall, weighing 50 kg engaged in light activity.

tailor

Resting(Basal) metabolic rate (BMR)

- Energy expended by an individual in a resting,
- 50 – 70 % of total energy
- Energy required for physiological functions
 - Respiration
 - Blood flow
 - Ion transport
 - Maintenance of cellular integrity.
- BMR in an adult,
 - 1,800 kcal for men (70 kg)
 - 1300 kcal for women (50 kg).



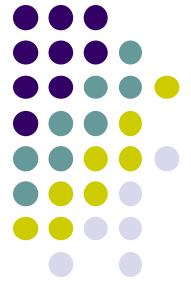
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Factor Affecting BMR

- Age
- Gender = Male > Female
- Physical activity
- Climate
- Body temperature
- Hormone level
 - Thyroid hormone , Androgen
- Pregnancy

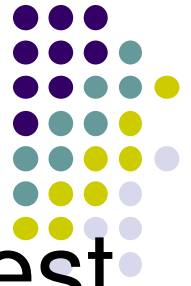
Thermic effect of food



- Heat production ,during the digestion and absorption of food, by the body increases as much as 30% above the resting level
- Thermic effect of food
- *Diet-induced Thermogenesis.*
- Over a 24–hour period, it has 5–10% of the total energy expenditure

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Physical activity



- Muscular activity provides the greatest variation in energy expenditure.
- Energy consumed depends on the duration and intensity of the exercise.
 - Sedentary person = 30–50% more calory than resting caloric requirement
 - highly active individual require 100% or more calories above the BMR

Acceptable Macronutrient Distribution Ranges



AMDR for adults

- **Carbohydrate = 45–65%**
- **Fat = 20–35%**
- **Protein = 10–35%**

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MACRONUTRIENT	RANGE (percent of energy)
Fat	20–35
n–6 Polyunsaturated fatty acids	5–10
n–3 Polyunsaturated fatty acids	0.6–1.2*
(Approximately ten percent of the total fat can come from longer-chain, n–3 or n–6 fatty acids.)	
Carbohydrate	45–65
● No less than 130 g/day	
(No more than 25 percent of total calories should come from added sugars.)	
Fiber	
● Men: 38 g	
● Women: 25 g	
Protein	10–35



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Significant of Plasma lipids & Dietary fat

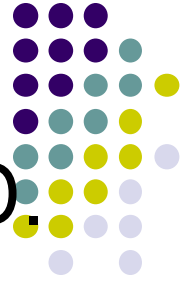
- Are fat, fatty acid and other lipid harmful only?

OR

- is all this having any positive significant?

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LDL & HDL



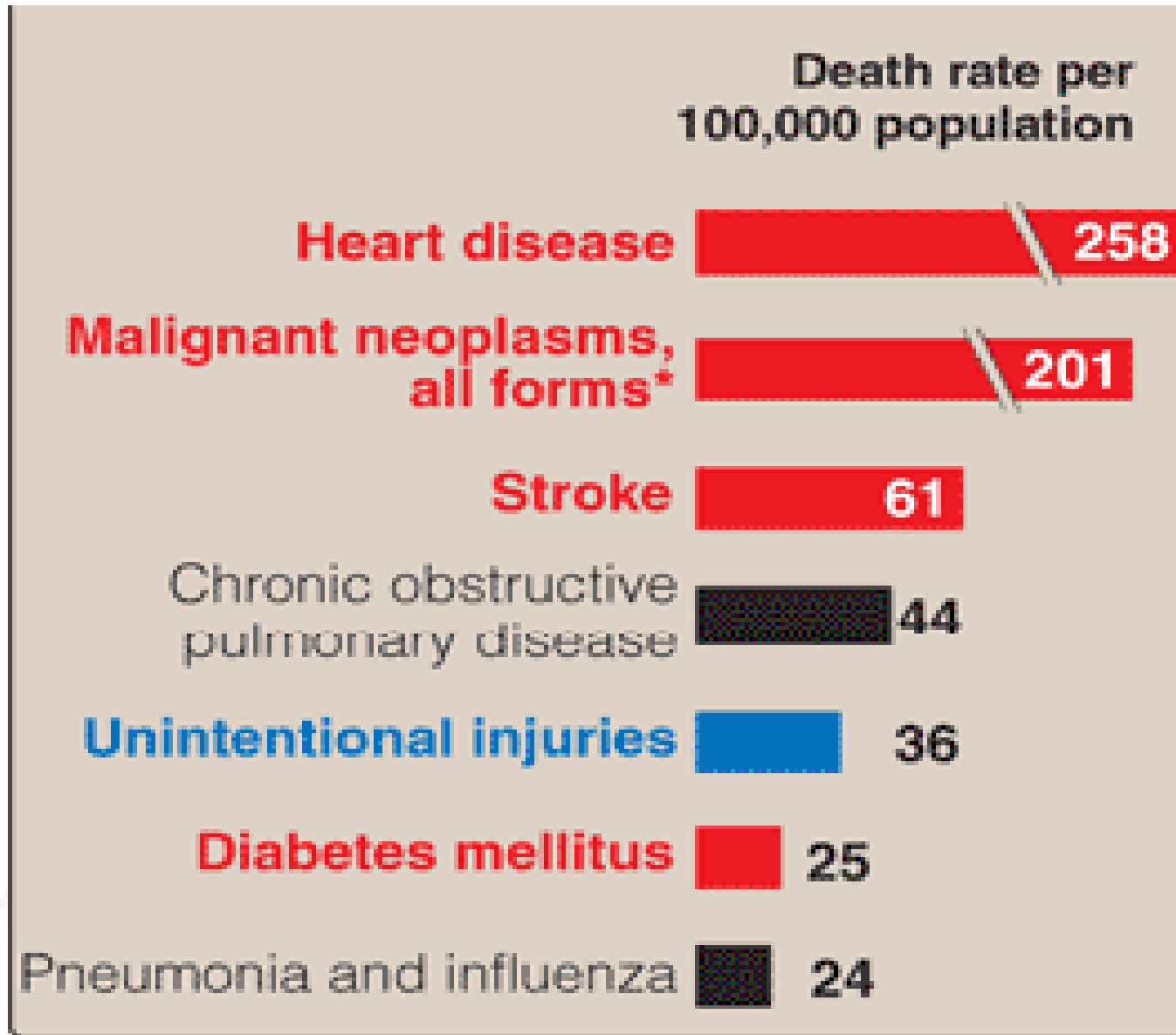
- High LDL cholesterol increases risk for IHD.
- High HDL cholesterol decrease risk for IHD.
- Chances of Complications due to Dyslipidemia increase with following risk factor
 - Smoking
 - Obesity
 - Sedentary lifestyle
 - Hypertension
 - Diabetes mellitus

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Beneficial effect of lowering Plasma Cholesterol



- Dietary or drug treatment of hypercholesterolemia
- Effective in
 - decreasing LDL
 - increasing HDL
 - reducing the risk for CAD
- Reduction of plasma cholesterol through
 - Diet control = 10–20%.
 - “Statin” drugs = 30–40%.



Red --- death due abnormal diet habit.

Blue --- death due to excessive alcohol ingestion



Saturated Fat

- Strongly associated with
 - High levels of total cholesterol
 - LDL cholesterol
 - Increased risk of CHD.
- The main sources
 - Dairy and meat products
 - Coconut and palm oils
- Most experts strongly advise limiting intake of saturated fats.

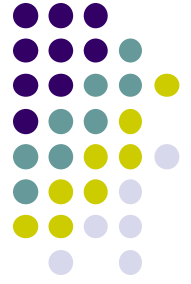
Monosaturated Fat

- Dietary Source - vegetables and fish.
- Monounsaturated FA
 - Lower total cholesterol
 - Lower LDL cholesterol.
 - Maintain or increase HDL cholesterol.
- Diets rich in olive oil.



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Polyunsaturated Fat



- Mainly two type
 - n-6 fatty acid
 - n-3 fatty acid

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- **Linoleic acid (18:2, Δ 9,12), n-6 fatty acid**
- **Linoleic acid (18:3, Δ 9,12,15), n-3 fatty acid**
- **(Essential Fatty Acid)**
 - **Lowers total cholesterol.**
 - **Lower LDL**
 - **Lower HDL .**
- **Nuts, Soybeans, Cottonseed oil and Corn oil**
- **Require in 5-10 % of total calories.**
- **More than 10 % intake may lead to deleterious products due to oxidation of these PUFAs.**

Polyunsaturated Fat

n-3 fatty acid



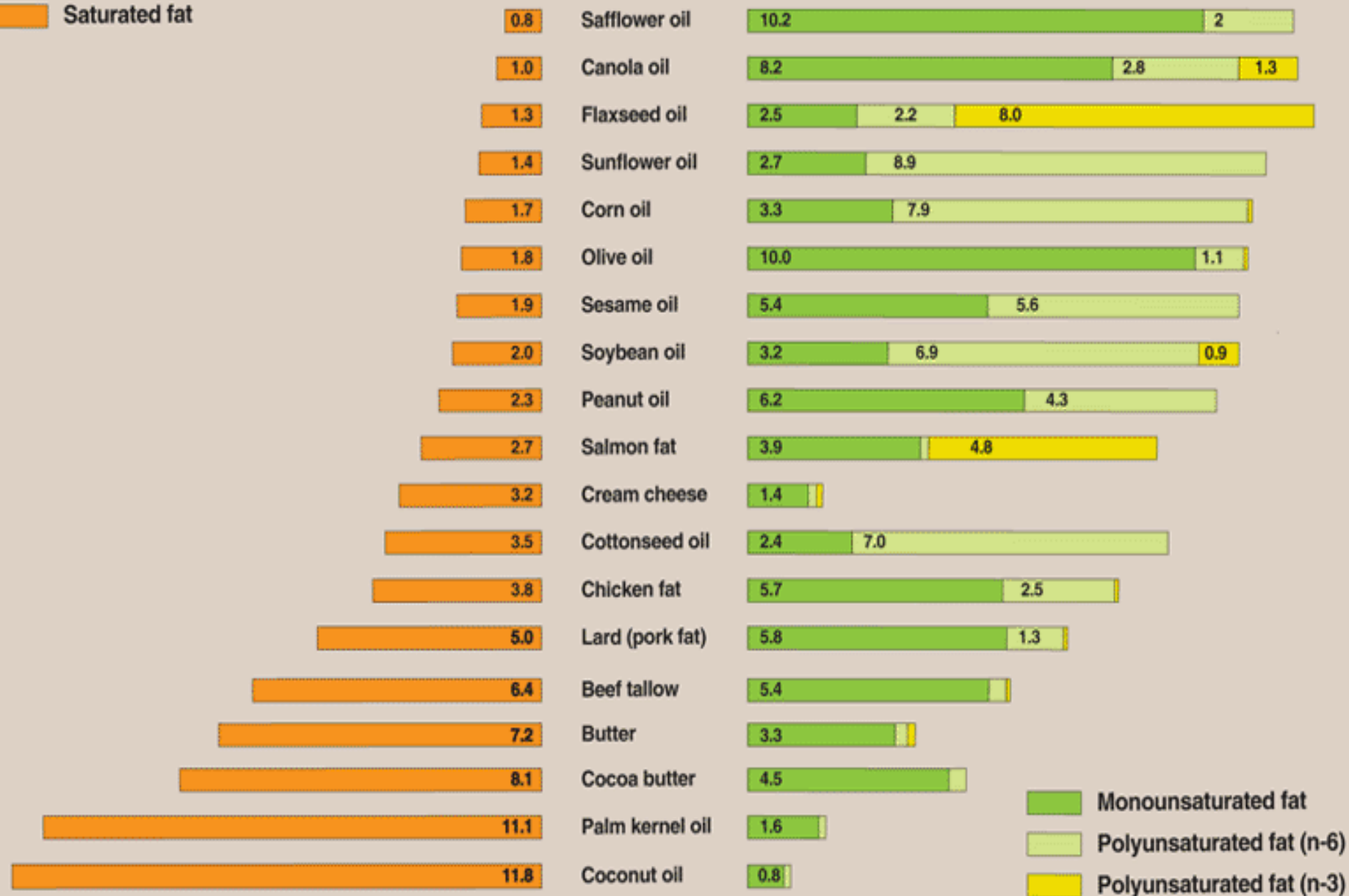
- Dietary n-3 PUFAs
 - Suppress cardiac arrhythmias
 - Reduce Serum Triglyceride
 - Decrease the tendency for thrombosis
 - Lower blood pressure
 - Reduce risk of cardiovascular mortality
- But , little effect on LDL or HDL cholesterol levels.
- Found in plants and in fish oil.
- Require 0.6 to 1.2 % of total calories.
- Two fish meals per week are recommended.
- Included in infant formulas




**Amount of saturated fat
(grams per tablespoon)**

Type of fat

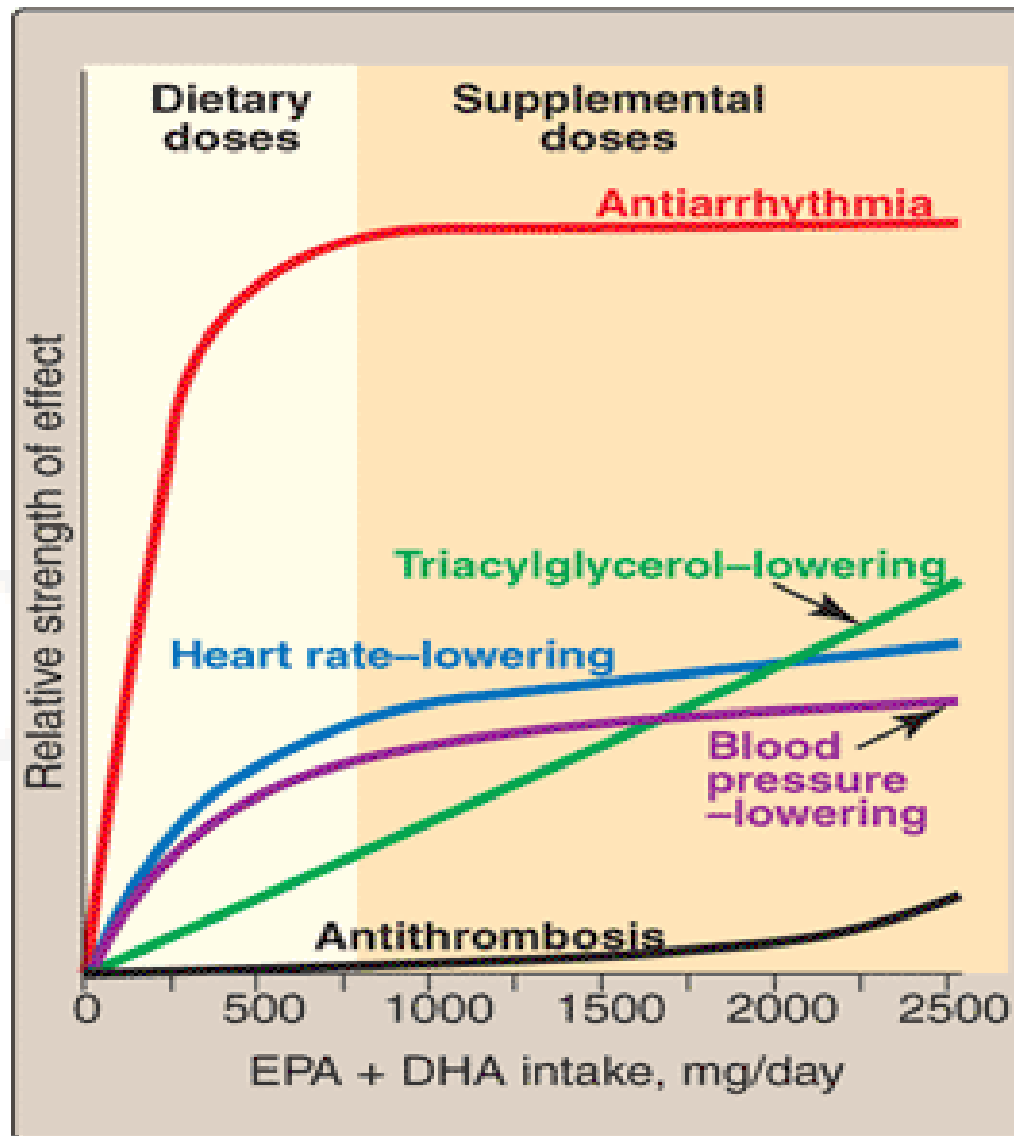
**Amount of unsaturated fat
(grams per tablespoon)**

 Saturated fat



 Monounsaturated fat
 Polyunsaturated fat (n-6)
 Polyunsaturated fat (n-3)

Dose responses of physiologic effects of fish oil intake

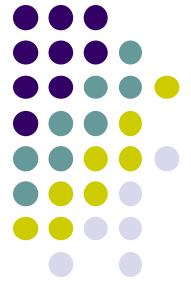




Trans fatty acids

- Unsaturated fatty acid.
- Elevate serum LDL
- Increase the risk of CHD.
- Formed during the hydrogenation of liquid vegetable oils.
- Trans fatty acids are a major component
 - Many commercial baked cookies and cakes
 - Most deep-fried foods.
- New York City, have banned the use of trans fats in restaurants.

Dietary Cholesterol



- Cholesterol is found only in animal products.
- The effect of dietary cholesterol on plasma cholesterol is less important than the amount and types of fatty acids consumed.

The words 'Partially hydrogenated' on the list of package ingredients indicate the presence of trans fatty acids in a food.

Other dietary factors affecting CHD



- Consumption of 25–50 g/day of soy protein causes 10 % decrease in LDL cholesterol in patients with elevated plasma cholesterol.
- Moderate consumption of alcohol (for example, two drinks a day) decreases the risk of CHD and increases concentration of HDLs.
- Red wine may provide cardioprotective benefits because it contains phenolic compounds that inhibit lipoprotein oxidation
- These antioxidants are also present in raisins and grape juice.

Effects of dietary fats



TYPE OF FAT	METABOLIC EFFECTS	EFFECTS ON DISEASE PREVENTION
Trans fatty acid	<p>↑ LDL ↓ HDL</p>	<p>↑ Incidence of coronary heart disease</p>
Saturated fatty acid	<p>↑ LDL Little effect on HDL</p>	<p>↑ Incidence of coronary heart disease; may increase risk of prostate, colon cancer</p>
Monounsaturated fatty acid	<p>↓ LDL ↓ HDL</p>	<p>↓ Incidence of coronary heart disease</p>
Polyunsaturated fatty acids n-6	<p>↓ LDL ↓ HDL</p> <p>Provides arachidonic acid which is an important precursor of prostaglandins and leukotrienes</p>	<p>↓ Incidence of coronary heart disease</p>
Polyunsaturated fatty acids n-3	<p>Little effect on LDL Little effect on HDL</p> <p>Suppress cardiac arrhythmias, reduce serum triacylglycerols, decrease the tendency for thrombosis, lower blood pressure</p>	<p>↓ Incidence of coronary heart disease</p> <p>↓ Risk of sudden cardiac death</p>

Dietary Carbohydrates



- The primary role of dietary carbohydrate is to provide energy.
- Carbohydrate consumption has significantly increased obesity.
- However, obesity has also been related to increasingly inactive lifestyles, and to calorie-dense foods.

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Monosaccharide

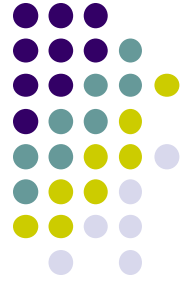


- **Glucose and fructose are the principal monosaccharides found in food.**
- **Glucose is abundant in fruits, sweet corn, corn syrup and honey.**
- **Free fructose is found together with free glucose and sucrose in honey and fruits.**

Disaccharide

- **The most abundant disaccharides are sucrose, lactose and maltose.**
- **Sucrose = “table sugar,”**
- **Lactose sugar found in milk.**
- **Maltose is a product of enzymic digestion of polysaccharides. It is also found in significant quantities in beer and malt liquors.**

Polysaccharide



- **Do not have a sweet taste.**
- **Starch is found in abundance in plants.**
- **Common sources = wheat and other grains, potatoes, dried peas and beans, and vegetables.**

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Fiber



- **Nondigestible carbohydrates**
- **Soluble fiber**
- **Osmotically active**
- **Form a viscous gel with a liquid.**
- **Fiber intake (AI)**
 - **25 g/day for women**
 - **38 g/day for men.**

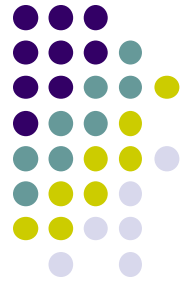
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Benefits of Fiber in Diet



- Adds bulk to the diet .
- Absorb 10–15 times its own weight in water
- Drawing fluid into the lumen of the intestine
- Increasing bowel motility.
- Delays gastric emptying
- Result in a sensation of fullness.
- Results in reduced high peaks of blood glucose level
- Decreases LDL cholesterol levels
 - by increasing fecal bile acid excretion
 - interfering with bile acid reabsorption.
- Decrease the risk for
 - Constipation ,Hemorrhoids

Actions of dietary fiber



Health effects

Reduces constipation and hemorrhoid formation, softens stools

Increases bowel motility, thus reducing exposure of gut to carcinogens

**Decreases absorption of dietary fat and cholesterol
Increases fecal loss of cholesterol**

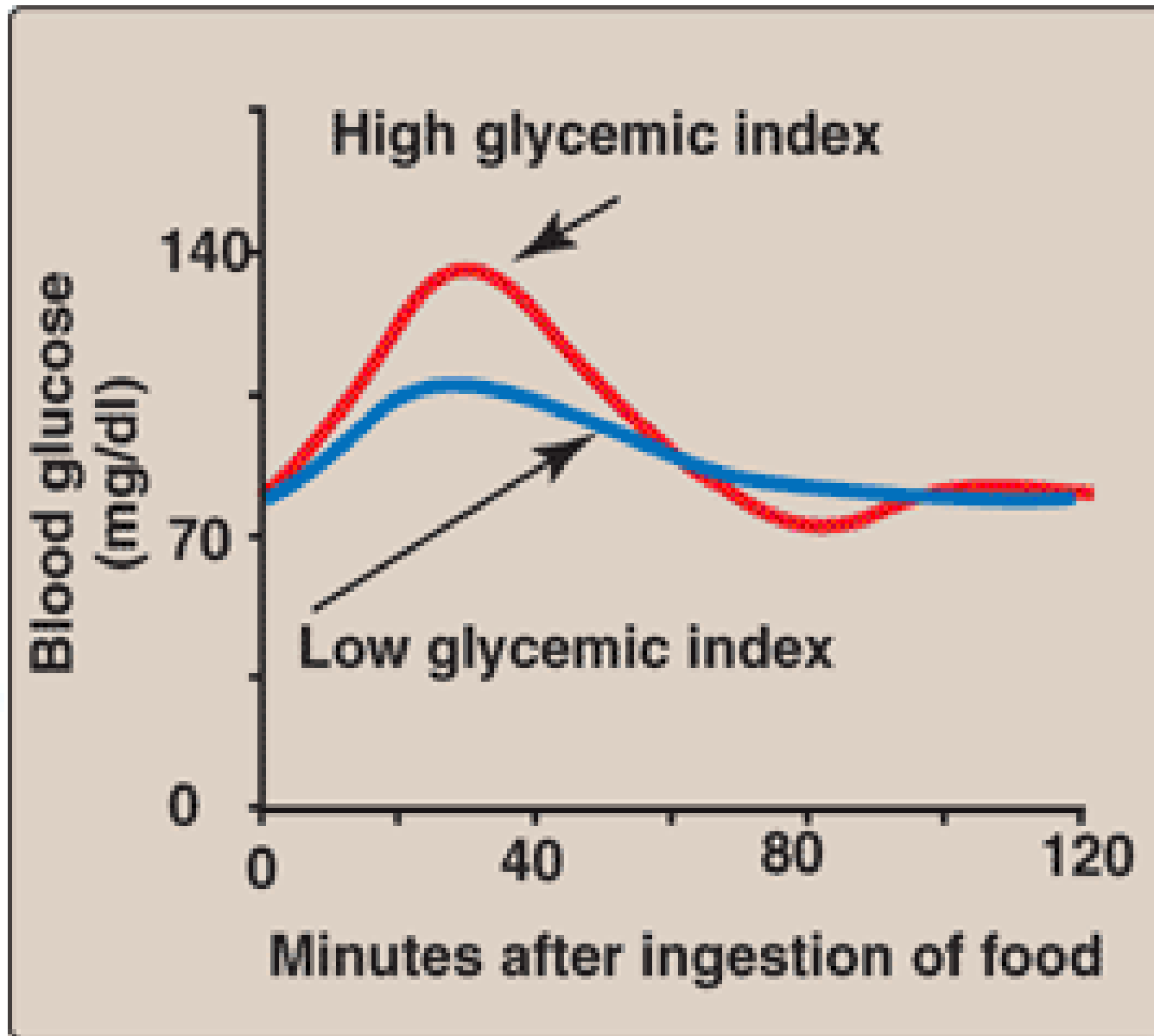
**Delays gastric emptying
Generates sensation of fullness
Reduces postprandial blood glucose concentration**

Dietary Carbohydrate & Blood Glucose



- Some carbohydrate produce a rapid rise followed by a steep fall in blood glucose concentration,
- whereas others result in a gradual rise followed by a slow decline.
- Glycemic index is defined as the area under the blood glucose curves seen after ingestion of a meal with carbohydrate-rich food, compared with the area under the blood glucose curve observed after a meal consisting of the same amount of carbohydrate in the form of glucose or white bread.
- Glycemic index of potato and white bread are similar to the response to pure glucose, indicating that complex carbohydrates may not differ from simple sugars in their effect on plasma glucose level.
- Food with a low glycemic index tends to create a sense of satiety over a longer period of time, and may be helpful in limiting caloric intake.

B. Glucose concentrations following ingestion of food with low or high Glycemic index.



Requirements for Carbohydrate



- **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 ketone body production and degradation of body protein.**
- **The RDA for carbohydrate is set at 130 g/day for adults and children, based on the amount of glucose used by carbohydrate-dependent tissues, such as the brain and erythrocytes.**
- **Adults should consume 45–65 percent of their total calories from carbohydrates.**

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Dietary Proteins

- Humans have no dietary requirement for protein but the protein in food does provide essential amino acids.
- Nine of the 20 amino acids needed for the synthesis of body proteins are essential—that is, they cannot be synthesized in humans.

Quality of Proteins

- It is a measure of its ability to provide the essential amino acids required for tissue maintenance.
- PDCAAS = Protein Digestibility-Corrected Amino Acid Scoring is the standard for evaluate protein quality.
- PDCAAS is based on the profile of essential amino acids and the digestibility of the protein.
- The highest possible score under these guidelines is 1.00.



Relative Quality of some common Dietary Proteins



Source	PDCAAS value
Animal proteins	
Egg	1.00
Milk protein	1.00
Beef/poultry/fish	0.82–0.92
Gelatin	0.08
Plant proteins	
Soybean protein	1.00
Kidney beans	0.68
Whole wheat bread	0.40

D

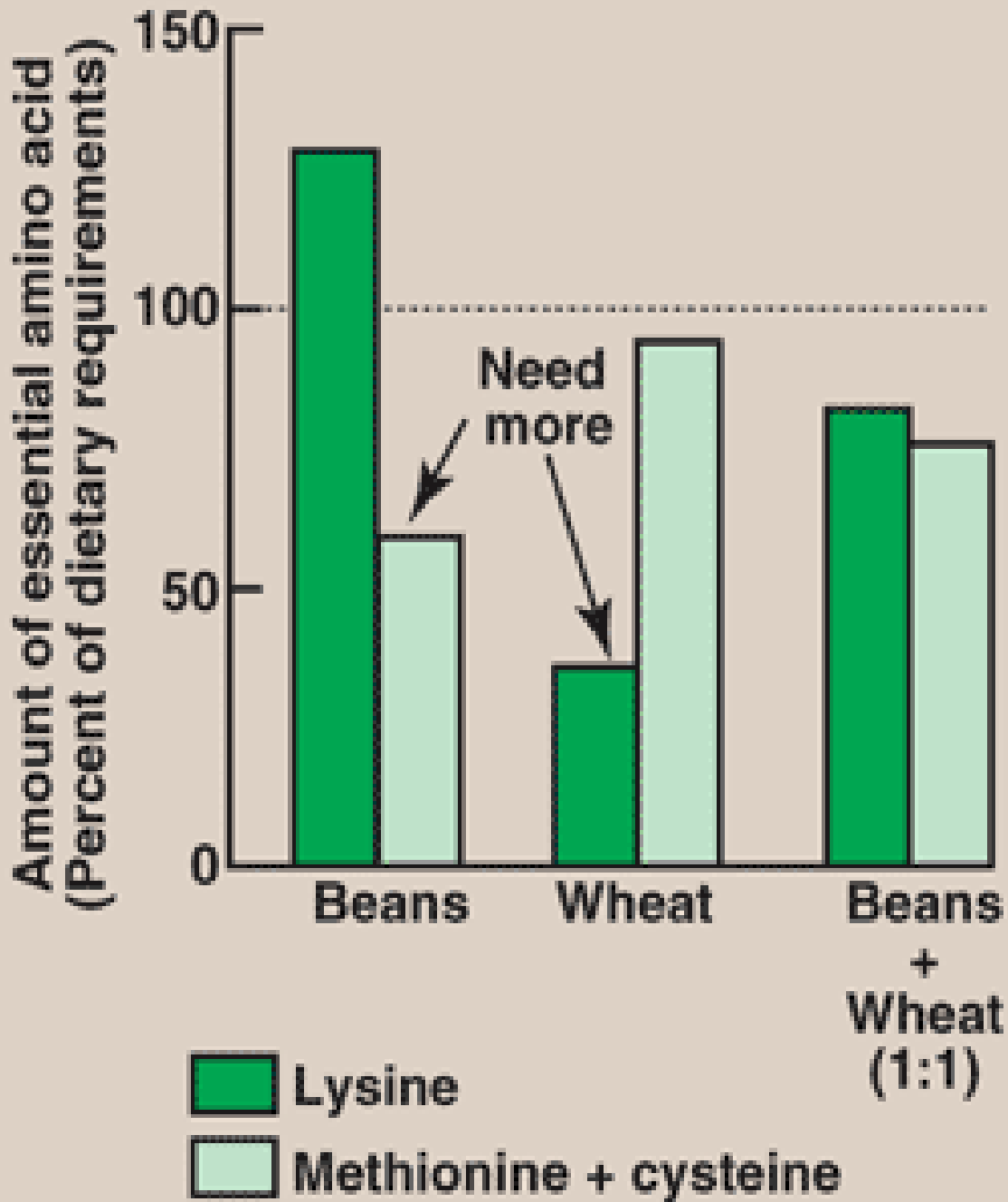
Proteins from animal sources

- Proteins from animal sources (meat, poultry, milk, and fish) have a high quality because they contain all the essential amino acids in proportions similar to those required for synthesis of human tissue proteins.
- Gelatin prepared from animal collagen is an exception; it has a low biologic value as a result of deficiencies in several essential amino acids.

Proteins from Plant sources

- Proteins from wheat, corn, rice, and beans have a lower quality than do animal proteins.
- However, proteins from different plant sources may be combined in such a way that the result is equivalent in nutritional value to animal protein.
- For example, wheat (lysine-deficient but methionine-rich) may be combined with kidney beans (methionine-poor but lysine-rich) to produce a complete protein of improved biologic value.
- Thus, eating foods with different limiting amino acids at the same meal (or at least during the same day) can result in a dietary combination with a higher biologic value than either of the component proteins





Combining two incomplete proteins that have complementary A.A. deficiencies results in a mixture with a higher biologic value.

Tailor

Nitrogen balance



- Nitrogen balance occurs when the amount of nitrogen consumed equals that of the nitrogen excreted in the urine, sweat, and feces. Normally, it remains balance.

Positive Nitrogen Balance

- This occurs when nitrogen intake exceeds nitrogen excretion.
- It is observed during situations in which tissue growth occurs, for example, in childhood, pregnancy, or during recovery from an emaciating illness.

Negative Nitrogen Balance

- This occurs when nitrogen loss is greater than nitrogen intake.
- It is associated with inadequate dietary protein, lack of an essential amino acid, or during physiologic stresses, such as trauma, burns, illness, or surgery.

Requirement for protein in humans



- The greater the proportion of animal protein included in the diet, the less protein is required.
 - The RDA for protein = 0.8 g/kg of body weight for adults.
 - Athletes = 1 g/kg protein daily.
 - Pregnant or lactating woman = 30 g/day.
 - children should consume 2 g/kg/day.
1. **Consumption Excessive Protein :**
 - No physiologic advantage to the consumption of more protein than the RDA.
 - Protein consumed in excess of the body's needs is deaminated,
 - When excess protein is eliminated from the body as urinary nitrogen, accompanied by increased urinary calcium, increasing the risk of nephrolithiasis and osteoporosis.
 2. **The Protein Sparing Effect of Carbohydrate :**
 - The dietary protein requirement is influenced by the carbohydrate content of the diet.
 - When the intake of carbohydrates is low, amino acids are deaminated to provide carbon skeletons for the synthesis of glucose that is needed as a fuel by the central nervous system.
 - If carbohydrate intake is less than 130 g/day, substantial amounts of protein are metabolized to provide precursors for gluconeogenesis. Therefore, carbohydrate is considered to be “protein-sparing,”

Protein-energy (calorie) malnutrition (PEM)



- Most frequently in hospital patients with chronic illness, major trauma, severe infection, or the effects of major surgery.
- Such highly catabolic patients frequently require intravenous (parenteral) or tube-based (enteral) administration of nutrients.
- Affected individuals show a variety of symptoms, including a depressed immune system with a reduced ability to resist infection.
- Death from secondary infection is common.
- Two extreme forms of PEM are kwashiorkor and marasmus.

Child with kwashiorkor



A child with kwashiorkor frequently shows a deceptively plump belly as a result of edema

Kwashiorkor



- Kwashiorkor occurs when protein deprivation is relatively greater than the reduction in total calories.
- Unlike marasmus, significant protein deprivation is associated with severe loss of visceral protein.
- Kwashiorkor is frequently seen in children after weaning at about one year of age, when their diet consists predominantly of carbohydrates.
- Typical symptoms include stunted growth, edema, skin lesions, depigmented hair, anorexia, enlarged fatty liver, and decreased plasma albumin concentration.
- Edema results from the lack of adequate plasma proteins to maintain the distribution of water between blood and tissues.

Marasmus



- Marasmus occurs when calorie deprivation is relatively greater than the reduction in protein.
- Marasmus usually occurs in children younger than one year of age when the mother's breast milk is supplemented with thin watery gruels of native cereals, which are usually deficient in protein and calories.
- Typical symptoms include arrested growth, extreme muscle wasting (emaciation), weakness, and anemia.
- Victims of marasmus do not show the edema or changes in plasma proteins observed in kwashiorkor.

