NUTRITION

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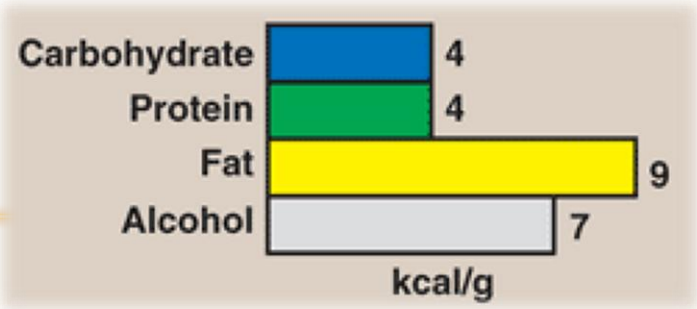
OVERVIEW

- Energy is provided mainly by 3 nutrient classes: fats, carbohydrates, & proteins
- Macronutrients vs. micronutrients (amount)
- The Estimated Energy Requirement is the average dietary intake predicted to maintain an energy balance in a healthy adult of a defined age, gender, and height whose weight and level of physical activity are consistent with good health
- Due to numerous differences, predictions are difficult, however, estimations are there
  - ✓ Sedentary adults (30 kcal/kg/day) to maintain body weight
  - ✓ Moderately active adults (35 kcal/kg/day)
  - ✓ Very active adults (40 kcal/kg/day)

ENERGY CONTENT OF FOOD & ITS USE

- Calculated from the heat released by the total combustion of food in a calorimeter
- Expressed in calories (kcal, or Cal) (1 Cal = 4.128 J)
- Energy of macronutrients is used for:
  - Resting (basal) metabolic rate: energy expended by an individual in a resting, post-absorptive state
  - It represents the energy required to carry out the normal body functions;
    - Respiration
    - Blood flow
    - Ion transport
    - Maintenance of cellular integrity

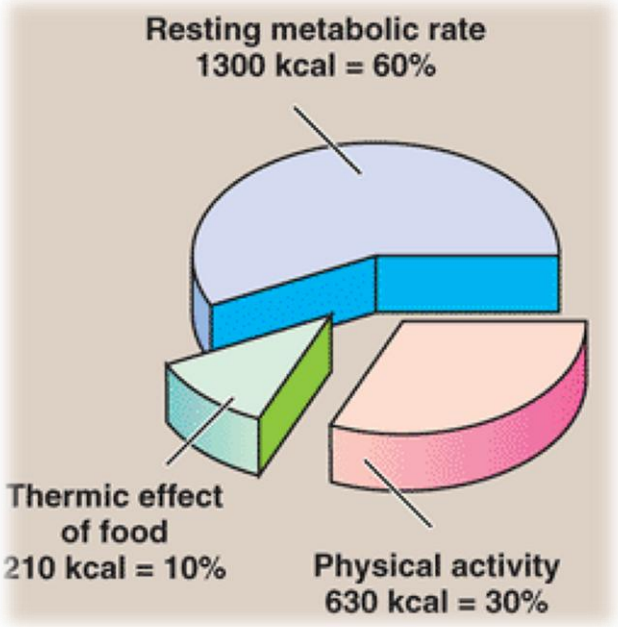
- In an adult, the RMR (BMR) is about 1,800 kcal for men (70 kg) and 1300 kcal for women (50 kg)



ENERGY CONTENT OF FOOD & ITS USE

- **Thermic effect of food: also called diet induced thermogenesis. It is the production of heat by the body due to digestion & absorption. It increases as much as 30% above RMR**

- **Physical activity: muscular activity provides the greatest variation in energy expenditure. Energy consumed depends on the duration and intensity of the exercise**



Estimated total energy expenditure in a typical 20-year-old woman, 165 cm (5 feet, 4 inches) tall, weighing 50 kg (110 lb), and engaged in light activity

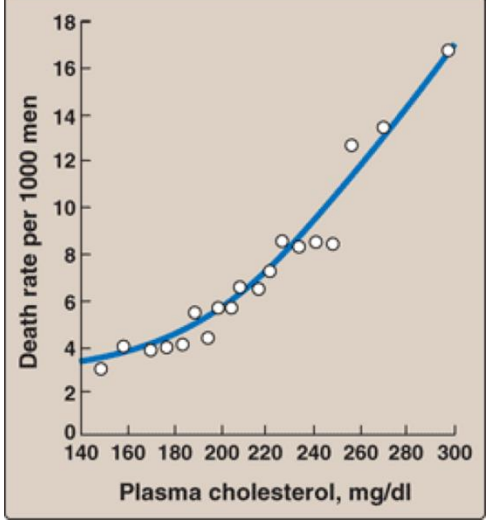
ACCEPTABLE MACRONUTRIENT DISTRIBUTION RANGES (AMDR)

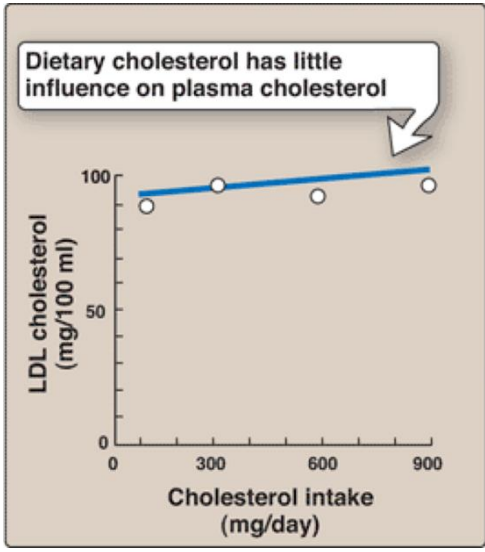
- A range of intakes for a particular macronutrient that is associated with reduced risk of chronic disease while providing adequate amounts of essential nutrients
- The AMDR for adults is 45–65% of their total calories from carbohydrates, 20–35% from fat, and 10–35% from protein

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

DIETARY FATS

- Cholesterol:
  - Sources: diet (animals) or endogenous biosynthesis
  - Transport: as lipoproteins (LDL, HDL) in combination with protein and phospholipids
  - The effect of dietary cholesterol on plasma cholesterol is low
  - CHD correlates with:
    - LDL but not HDL
    - Abnormal levels of plasma lipids (dyslipidemias)
    - TAGs in combination with smoking, obesity and sedentary lifestyle

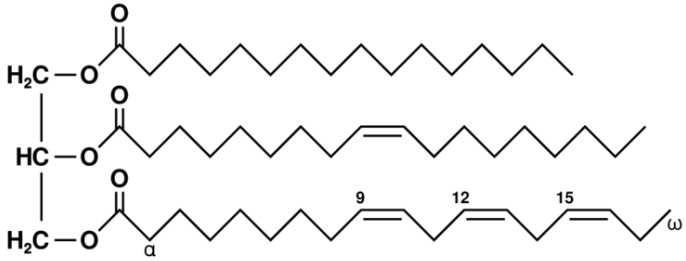




- Drugs (statin) are more effective in decreasing plasma cholesterol level (30-40%) than diet-induced changes (10–20%)

DIETARY FATS & PLASMA LIPIDS

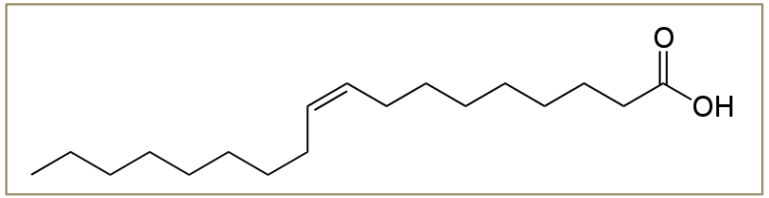
- **Triacylglycerols are quantitatively the most important class of dietary fats.**



- ✓ **Fatty acids are either:**
  - ✓ **Saturated:**
    - ✓ **Strongly associated with high plasma cholesterol and LDL and increased risk of CHD**
    - ✓ **Carbon chain lengths of 14 (myristic) and 16 (palmitic) are most potent in increasing the serum cholesterol levels while stearic acid (18 carbons—found in many foods including chocolate) produces only modest increases in blood cholesterol**
    - ✓ **The main sources of saturated fatty acids are dairy & meat products and some vegetable oils, such as palm oils**

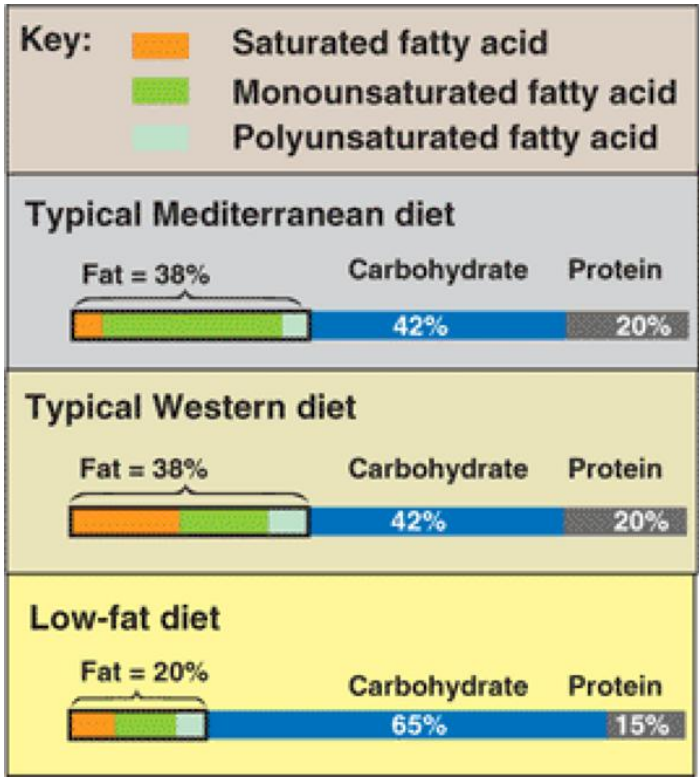
DIETARY FATS & PLASMA LIPIDS

- **Monounsaturated:**
  - Generally derived from vegetables and fish
  - They lower both total plasma cholesterol & LDL cholesterol, but maintain or increase HDL cholesterol
  - Explain, in part, the observation that Mediterranean cultures, with diets rich in olive oil (high in monounsaturated oleic acid), show a low incidence of CHD



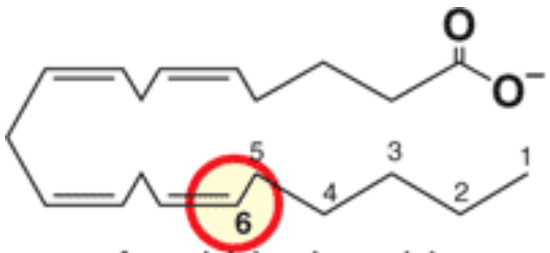
THE MEDITERRANEAN DIET

- Is an example of a diet rich in (MUFAs) monounsaturated fatty acids (olive oil) & n-3 fatty acids (fish oils and nuts)
- Low in saturated fat
- Contains seasonally fresh food, with an abundance of plant material, low amounts of red meat, and olive oil as the principal source of fat
- Associated with decreased serum total cholesterol and LDL cholesterol
- Western diet is higher in saturated fats



DIETARY FATS & PLASMA LIPIDS

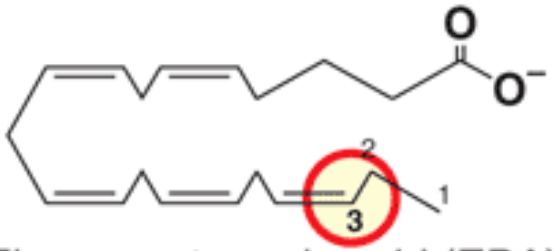
- ✓ **Polyunsaturated (PUFAs):**
- ✓ **Double bond location correlates with cardiovascular disease**
- ✓ **n-6 Fatty acids:**
  - ✓ **Principally linoleic acid (18:2, Δ9,12) obtained from vegetable oils, lowers plasma cholesterol when substituted for saturated fats**
  - ✓ **Plasma LDL and HDL are lowered**
  - ✓ **Nuts, olives, and various oils (sesame, corn), are common sources of these fatty acids**



Arachidonic acid
(20:4, n-6)
found in seed oils

DIETARY FATS & PLASMA LIPIDS

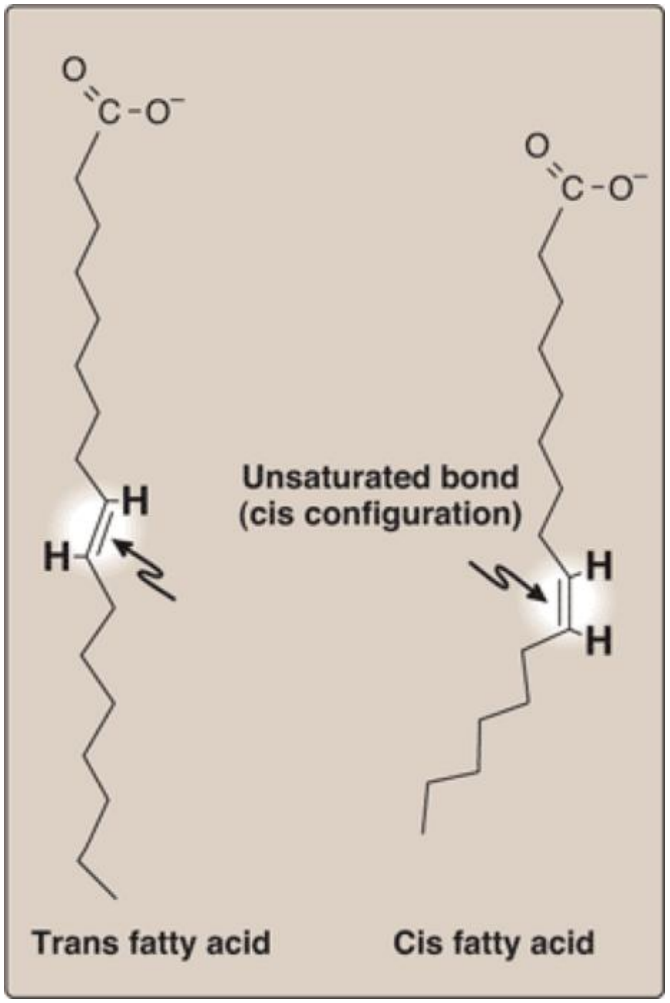
- ✓ **n-3 Fatty acids:**
  - ✓ **Principally, linolenic acid**
  - ✓ **Suppress cardiac arrhythmias, reduce serum TAGs, decrease the tendency for thrombosis, lower blood pressure, and substantially reduce risk of cardiovascular mortality**
  - ✓ **They have little effect on LDL or HDL levels**
  - ✓ **Found in plants & in fish oil**
  - ✓ **Two fish meals/week are recommended**
  - ✓ **They are included in infant formulas**



Eicosapentaenoic acid (EPA)
(20:5, n-3)
found in fish oils

DIETARY FATS & PLASMA LIPIDS

- ✓ **Trans fatty acids:**
  - ✓ **Behave more like saturated (elevate LDL but not HDL), so increase the risk of CHD**
  - ✓ **Do not occur naturally in plants, but occur in small amounts in animals**
  - ✓ **Formed during hydrogenation of liquid vegetable oils (manufacture of margarine)**
  - ✓ **Major component of many commercial baked goods, such as cookies, cakes, & most deep-fried foods**
  - ✓ **'partially hydrogenated' means trans fatty acids**



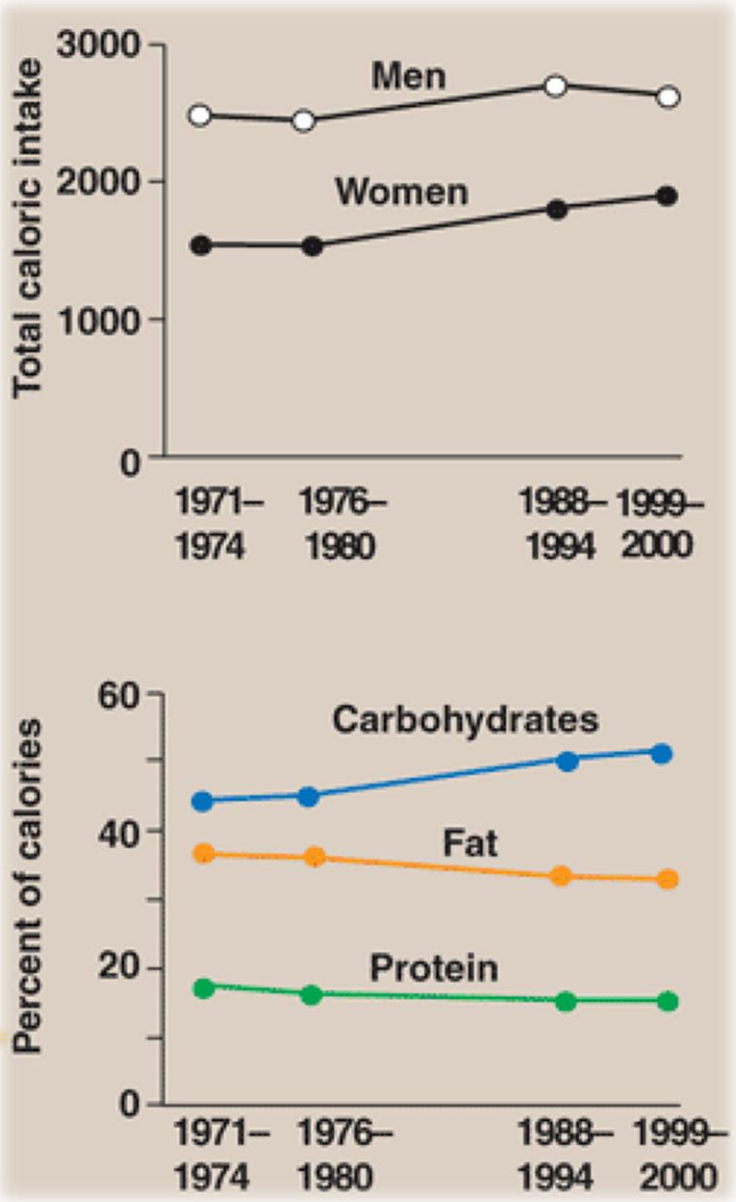
OTHER DIETARY FACTORS AFFECTING CHD

- **Alcohol consumption: moderately (two drinks a day) decreases the risk of CHD (↑HDLs)**
- **Red wine (phenolic compounds) inhibit lipoprotein oxidation. Also present in raisins and grape juice**

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

DIETARY CARBOHYDRATES

- The primary role is to make energy
- In US, since 1971, caloric intake slightly increased, but obesity dramatically increased
- Classification of carbohydrates
  - Simple sugars:
    - Monosaccharides: mainly Glucose and fructose. Abundant in fruits, corn, & honey



DIETARY CARBOHYDRATES

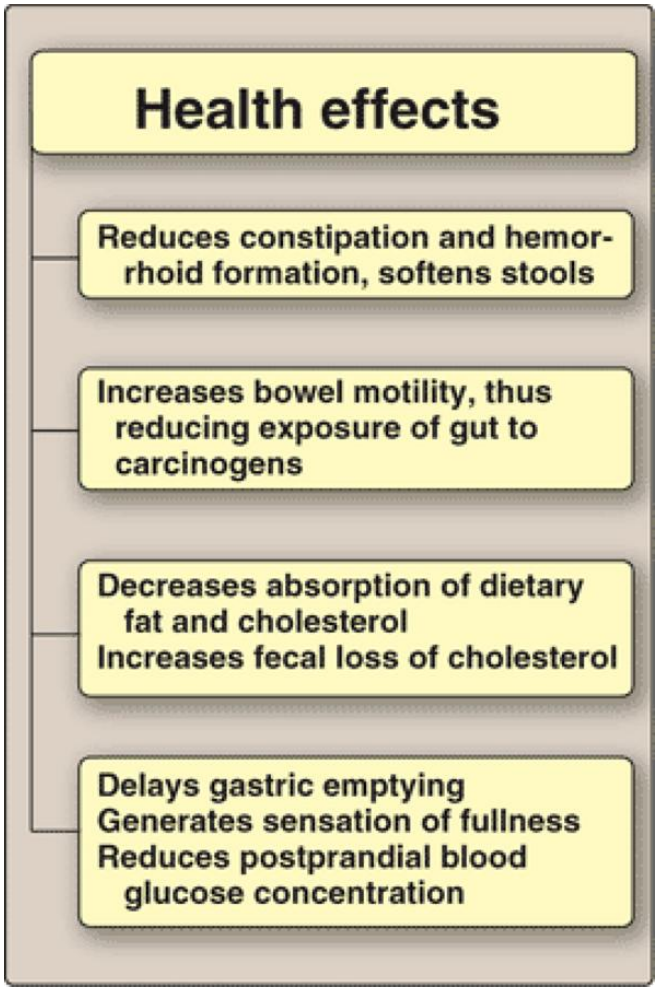
- **Disaccharides:**
  - **The most abundant are**
    - **Sucrose (glucose + fructose): table sugar**
    - **Lactose (glucose + galactose): milk**
    - **Maltose (glucose + glucose): a product of enzymic digestion of polysaccharides. It is also found in significant quantities in beer and malt liquors**

- **Complex sugars (Polysaccharides): no sweet taste, most often polymers of glucose. Starch is an example, abundant in plants**

- **Fibers: nondigestible carbohydrates, present in plants**

DIETARY CARBOHYDRATES

- Dietary fiber provides little energy but has several beneficial effects
  - Adds bulk to the diet (delays emptying, sensation of fullness)
  - Absorb water (10–15) times its weight
  - Lower LDL (increasing fecal bile acid excretion and interfering with bile acid reabsorption)
  - The recommended daily fiber intake is 25 g/day for women and 38 g/day for men



CARBOHYDRATES & DISEASES

- Carbohydrates are not essential nutrients, however, the absence of dietary carbohydrate leads to ketone body production (recommended Daily Allowance, RDA, is130 g/day)
- There is NO direct evidence that the consumption of simple sugars is harmful
- Contrary to folklore, diets high in sucrose do not lead to diabetes. Also contrary to popular belief, carbohydrates are not inherently fattening (4 kcal/g) & result in fat synthesis only when consumed in excess of the body's energy needs
- There is an association between sucrose consumption & dental caries, particularly in the absence of fluoride treatment

DIETARY PROTEINS (9)

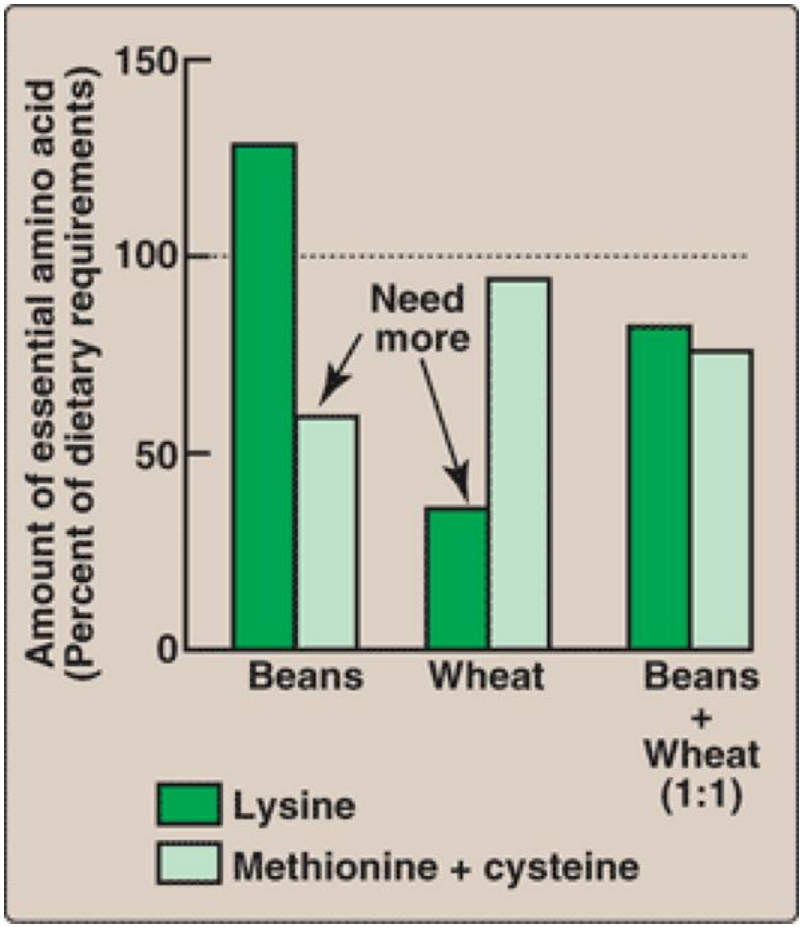
- What is “Quality of proteins”? is a measure of its ability to provide the essential amino acids
- Protein Digestibility-Corrected Amino Acid Scoring (PDCAAS) as the standard by which to evaluate protein quality

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

- PDCAAS is based on the profile of essential amino acids and the digestibility of the protein (highest 1.00)
- Animal proteins:(meat, milk, and fish) have a high quality (gelatin is an exception)

DIETARY PROTEINS

- Plant proteins: (wheat, corn, rice, and beans) have a lower quality than animal proteins
- Different plant sources correct it: ex., 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



NITROGEN BALANCE & PROTEIN REQUIREMENTS

- Most healthy adults are normally in nitrogen balance
- Positive nitrogen balance (childhood, pregnancy) vs. negative nitrogen balance (malnutrition of protein's essential amino acids, or during physiologic stresses such as trauma, burns, illness, or surgery)
- The amount of dietary protein required is 0.8g/kg for adults, 1 g/kg for athletes, 2g/kg for children, 30g/day plus the adult requirements for pregnants and lactating
- There is NO physiologic advantage to the consumption of more protein. When excess protein is eliminated from the body as urinary nitrogen, it is often accompanied by increased urinary Ca^{+2}, increasing the risk of nephrolithiasis and osteoporosis
- The protein-sparing effect of carbohydrate (carbohydrates spare energy requirements from proteins)

PROTEIN-CALORIE MALNUTRITION

- Is seen most frequently in patients with chronic illness, major trauma, severe infection, or major surgery
- Symptoms: a depressed immune system with a reduced ability to resist infection. Death from secondary infection is common
- Kwashiorkor: protein deprivation is relatively greater than the reduction in total calories. Severe loss of visceral protein. Frequently seen in children after weaning (1 year). Typical symptoms include stunted growth, edema, skin lesions, depigmented hair, anorexia, enlarged fatty liver, and decreased plasma albumin concentration
- Marasmus: calorie deprivation is relatively greater than the reduction in protein. Usually occurs in children younger than 1 year. Typical symptoms include arrested growth, extreme muscle wasting, weakness, and anemia. No edema