Nutritional Requirements

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Objectives

By the end of this lecture, the Second Year students will be able to:

- Understand the basic terms of nutritional requirements that are important for establishing intake of a nutrient in a population
- Interpret 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
- Discuss energy requirement in humans including basic energy expenditure and the factors that affect it.
- Understand total parenteral nutrition (TPN) and its applications

Overview

- What is nutrition?
- Assessment of malnutrition
- Dietary reference intakes (DRIs)
- Estimated Average Requirement (EAR)
- Recommended Dietary Allowance (RDA)
- Adequate Intake (AI)
- Acceptable Macronutrient Distribution Ranges (ADMR)
- The Food Pyramid: dietary guidelines and goals
- Energy requirement and expenditure in humans
- Total parenteral nutrition (TPN)

What is nutrition?

- Composition and quantity of food intake by living organisms
- Biochemical utilization of food
- Human nutrition is divided into three areas:
  - Undernutrition (nutrient deficiency)
  - Overnutrition (excessive nutrient intake)
  - Optimal nutrition (balanced nutrient intake)

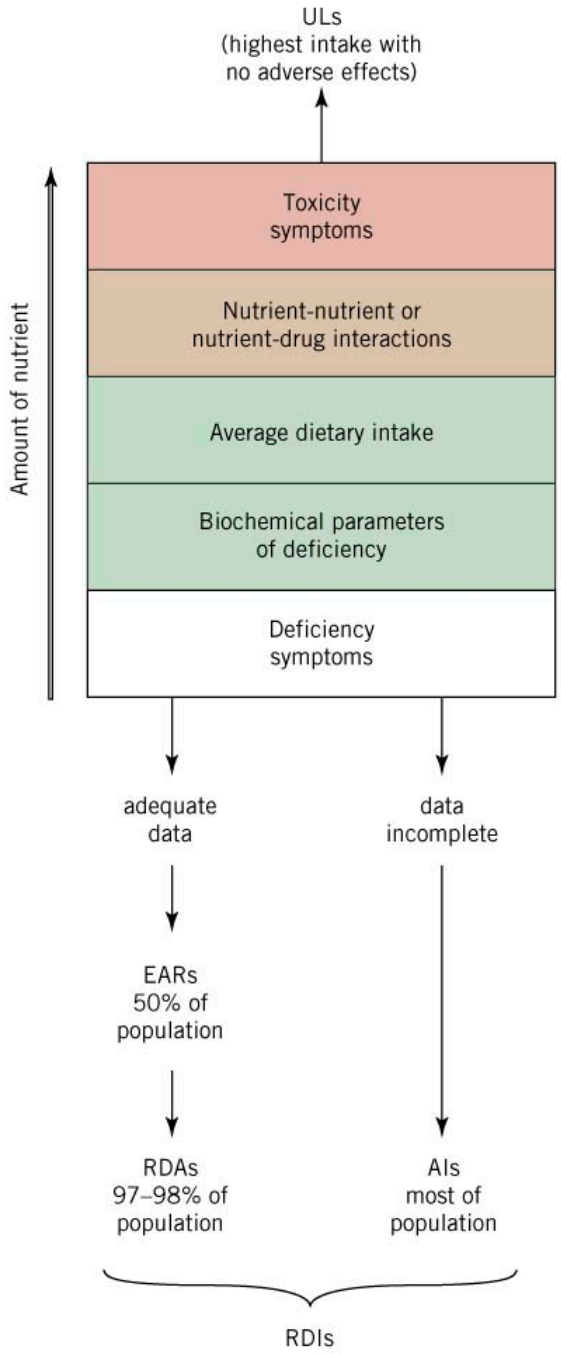
Assessment of malnutrition

- Malnutrition in humans is measured by:
- **Dietary intake studies:** identify people with deficient diets
- **Biochemical studies:** identify subclinical nutritional deficiencies
- **Clinical symptoms:** identify clinical nutritional deficiencies

Dietary Reference Intakes (DRIs)

- Quantitative estimates of nutrient intakes required to prevent deficiencies and maintain optimal health in populations
- Recommended by: Food and Nutrition Board of the National Research Council, USA

Dietary Reference Intakes (DRIs)



Dietary Reference Intakes (DRIs)

DRIs have four standards:

- **Estimated Average Requirement (EAR)**
- **Recommended Dietary Allowance (RDA)**
- **Adequate Intake (AI)**
- **Tolerable Upper Intake Level (UL)**

Estimated Average Requirement (EAR)

- **The amount of nutrient intake estimated to meet the nutritional requirement of *half of the healthy individuals (50%)* in an age and gender group**

Recommended Dietary Allowance (RDA)

- The amount of nutrient intake that is sufficient to meet the nutritional requirement of ***nearly all (97-98%) healthy individuals*** in a group
- RDA is two SD above EAR
- RDA = EAR + 2 SD

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
- **AI** 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**

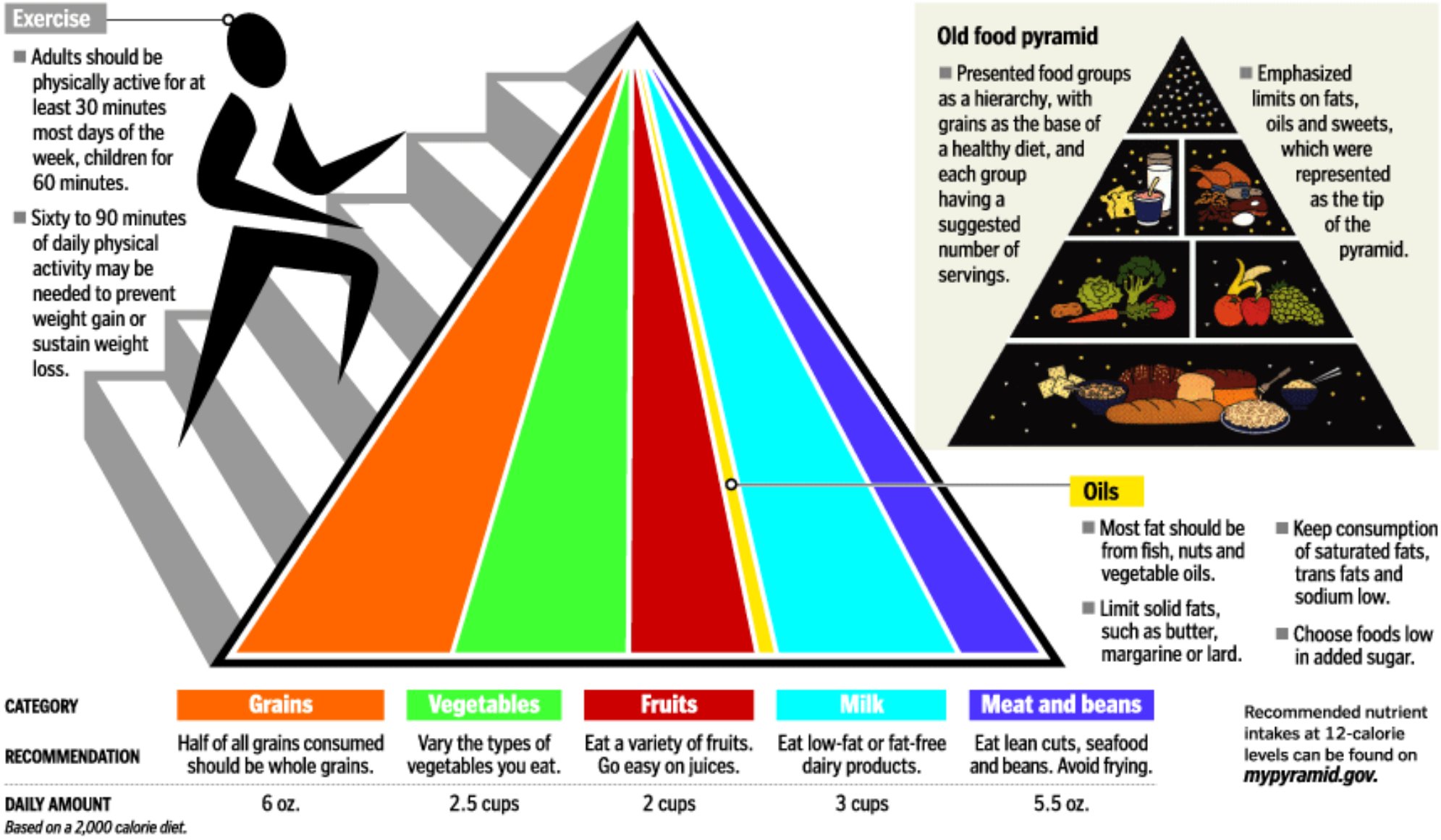
Acceptable Macronutrient Distribution Ranges (ADMR)

- Range of adequate intake of a macronutrient associated with reduced risk of chronic diseases
- **ADMR** for adults (% of total calories)
  - Carbohydrates 45-65
  - Fats 20-35
  - Proteins 10-35
  - Fiber >25 g

Food Pyramid

United States Department of Agriculture
Center for Nutrition Policy and Promotion

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

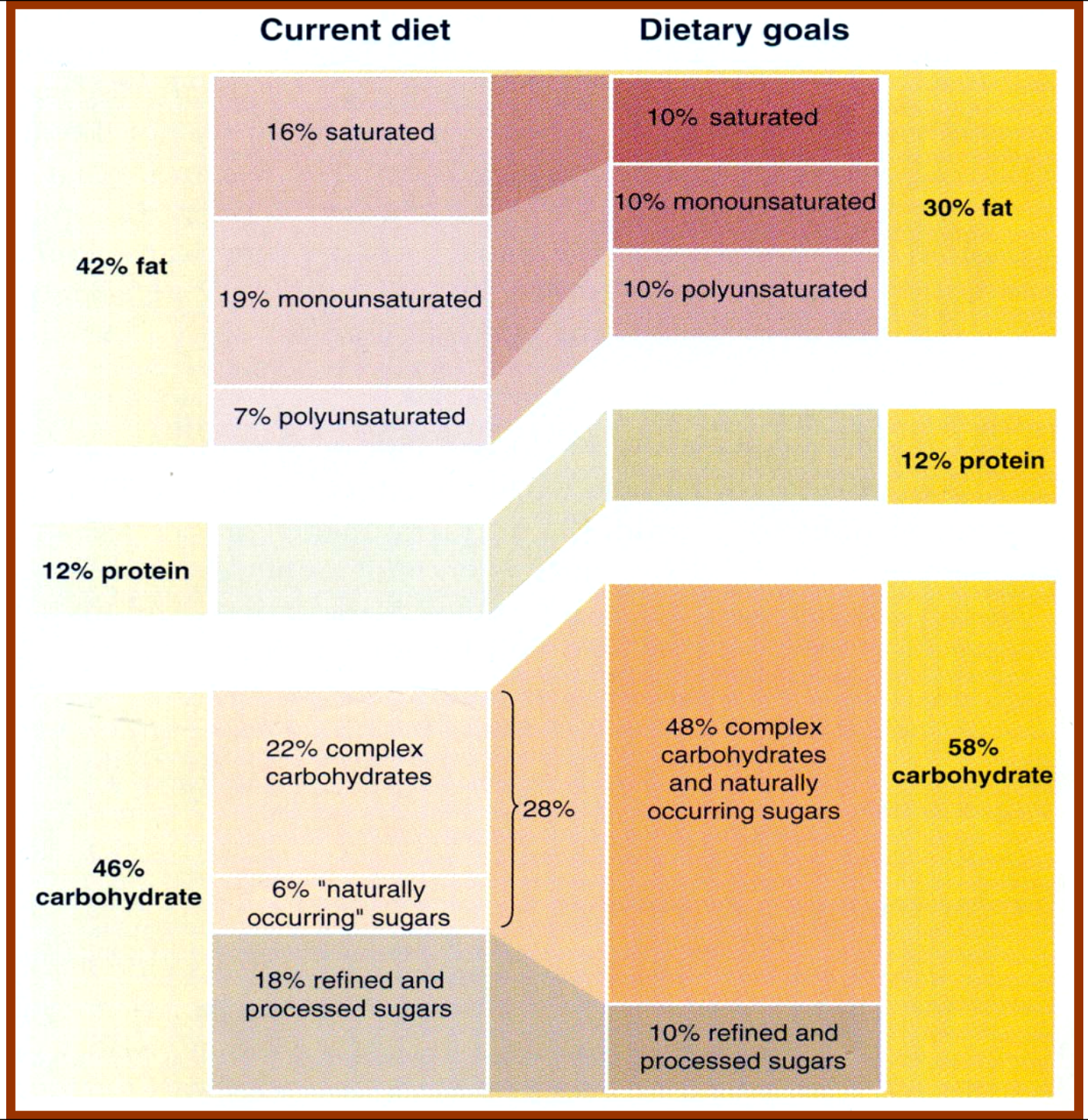


The Food Pyramid

Dietary guidelines and goals

- Consume a variety of foods from the basic food groups
- Control calorie intake to manage body weight
- Be physically active everyday
- Choose fats and CHOs wisely for good health
- Increase daily intake of fruits, vegetables, whole grains, and non-fat or low-fat milk and milk products
- Choose and prepare foods with little salt

Dietary Goals



Energy requirement in humans

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

Energy requirement in humans

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

Vegetarians and nutrient intake

- Lower intake of iron, calcium and vitamin D
- Long-term vegans may develop megaloblastic anemia due to vitamin B_{12} deficiency
- Most consume enough protein
- Lower in total dietary fat

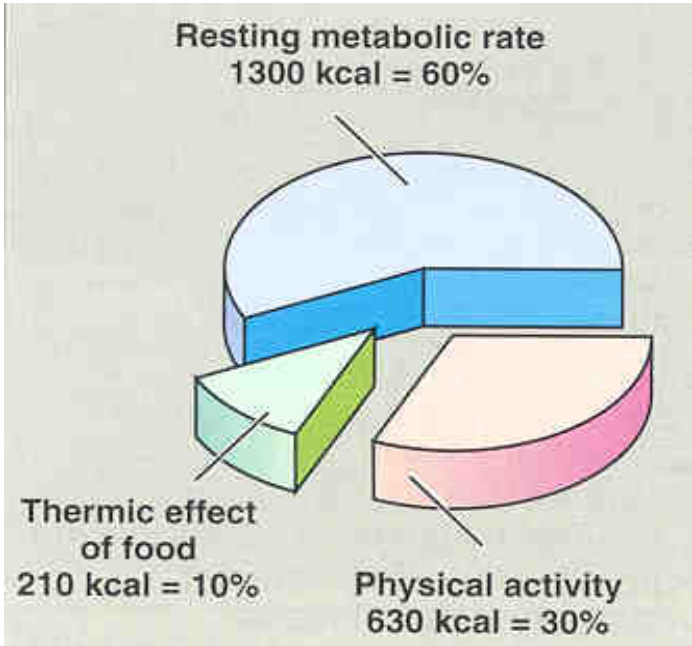
Vegetarians and chronic disease

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

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



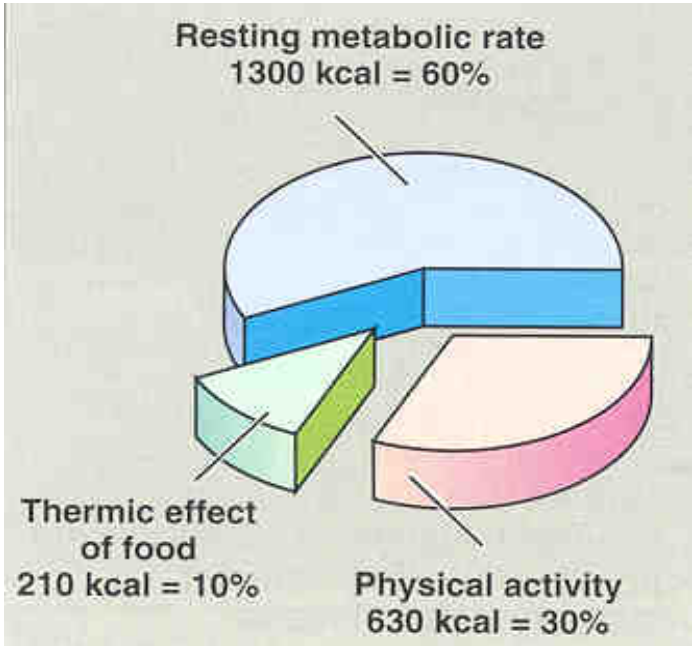
Basic energy expenditure depends on:

Physical activity

- Sedentary person: **30-50%** above RMR
- Active person: **100%+** above RMR

Thermic effect of food

- Heat produced by the body due to food digestion and absorption
- **5-10%** of total energy expenditure



Total Parenteral Nutrition (TPN)

- 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, coma, cachexia, prolonged ileus and extensive burns
- Nutrients are pumped into a large central vein to allow rapid dilution of the solution (3 L / 24 hr)
- Tube feeding is only provided to patients whose GI tract is intact and supports this type of nutrition

Total Parenteral Nutrition (TPN)

- 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
- Continuous biochemical, hematological and immunological monitoring of patient on TPN is required

Take home message

- Basic standards of nutritional requirements are important for malnutrition assessment
- Establishing these standards is essential for a population in order to avoid disease and maintain good health
- Committees of American and Canadian experts organized by the Food and Nutrition Board of National Academy of Sciences have established Dietary Reference intakes (DRIs).
- The DRIs replace and expand on the recommended Dietary Allowances (RDA)

References

- Lippincott's Biochemistry. 5th Edition, pp. 357-360. Lippincott Williams & Wilkins, New York, USA.

- Lecture Notes on Clinical Biochemistry 9th Edition A.F. Smith, Blackwell Publishing, UK.