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SCHOOL *of* PUBLIC HEALTH

## *Introduction*

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Benjamin Caballero, MD, PhD  
Johns Hopkins University



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## *Section A*

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Overview of the Course and the Science of Nutrition

- Defining nutritional needs of individuals and groups
- Major nutrient groups
  - Macronutrients (protein, energy, fat)
  - Micronutrients (vitamins, minerals)
- Diet and disease—obesity, chronic diseases, undernutrition
- Nutrition during the life cycle—pregnancy, newborn, child, adolescent

# *You Are What You Eat*



Giuseppe Archimboldo, *The Four Seasons*, 1573

- Nutrition studies the interaction between the individual and the environment mediated by food

## **Areas of Study**

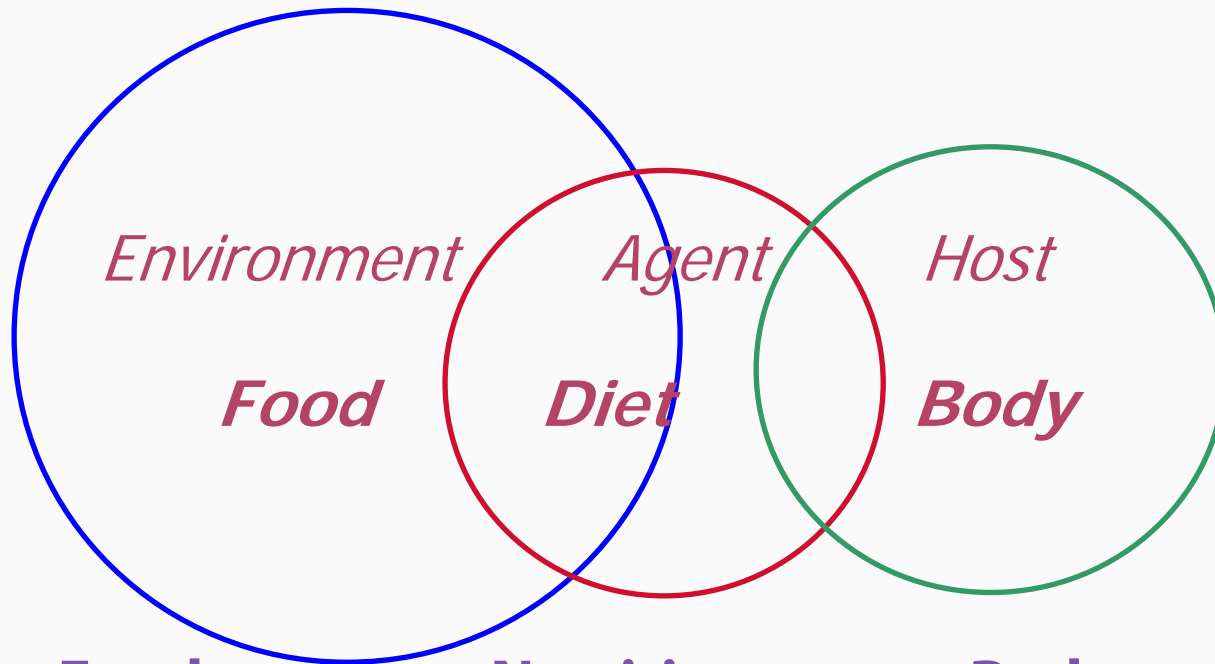
- Food production
- Diet composition (including non-nutritive substances)
- Food intake, appetite, food preferences
- Digestion and absorption of nutrients
- Intermediary metabolism, nutritional biochemistry

## **Areas of Study**

- Biological actions of essential nutrients
- Nutrient requirements in individuals and populations
- Health effects of nutrient deficiencies and excesses
- Long-term effects of diet constituents
- Therapeutic and preventive effects of foods



# Food, Nutrition, and the Body



## **Food**

Production  
Distribution  
Hygiene  
Preparation  
Food labels  
Meals

## **Nutrition**

Carbohydrates  
Proteins  
Fats  
Vitamins  
Minerals

## **Body**

Genetics  
Physiology  
Lifestyle  
Needs

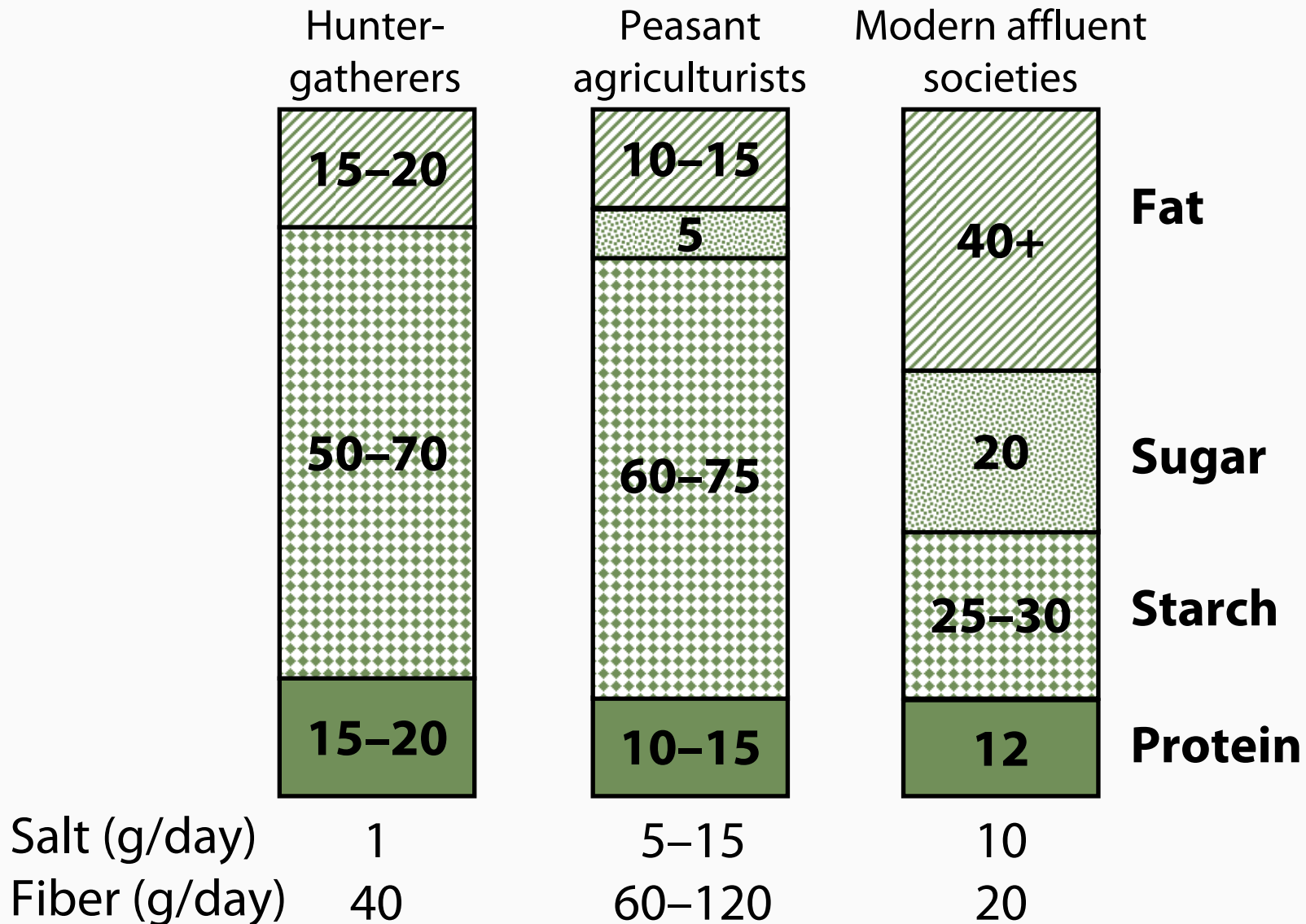
# *What Is a Healthy Diet?*

- Fulfills energy needs (macronutrients)
- Provides sufficient amounts of essential nutrients (micronutrients)

# *What Is a Healthy Diet?*

- Fulfills energy needs (macronutrients)
- Provides sufficient amounts of essential nutrients (micronutrients)
- Reduces risk of disease
- Is safe to consume (low contaminants or potentially harmful added substances)

# Evolution of the Human Diet





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## *Section B*

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DRI, RDA, and EAR

## ***Requirement***

- Minimum amount of a nutrient needed to sustain a physiological state, function, or structure in an individual

## ***Recommendation***

- Normalized estimate of nutrient needed to cover most individuals in a population group

## ***Guideline***

- Advice on diet composition to population groups, aimed at maintaining health and preventing diseases



“What is the minimum cost per head per week for which food can be bought in such quantity and in such quality as will avert starvation disease from the unemployed population?”  
— *Dr. E. Smith, England, 1862*

“... levels of intake of essential nutrients considered, in the judgment of the Food and Nutrition Board on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of practically all healthy persons.”

— *NRC, 1974, 1980, 1989*

# Sources of Data for Definition of Requirements

Source	Advantages	Disadvantages
<i>Metabolic experiments</i>	<ul style="list-style-type: none"><li>• Controlled conditions</li><li>• Isolated nutrients may be studied</li></ul>	<ul style="list-style-type: none"><li>• Small groups</li><li>• Short-term</li><li>• Inter-individual variability</li></ul>
<i>Food intake surveys</i>	<ul style="list-style-type: none"><li>• Actual eating patterns of populations</li><li>• Cultural factors</li></ul>	<ul style="list-style-type: none"><li>• Inaccurate methods</li><li>• Lack of food composition data</li></ul>
<i>Factorial calculations</i>	<ul style="list-style-type: none"><li>• Likely to cover most of the population</li><li>• Physiologically sound</li></ul>	<ul style="list-style-type: none"><li>• Tends to amplify errors due to limited or inaccurate information</li></ul>

# *Dietary Reference Intakes (DRIs)*

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

# *Scientific Basis for Establishing DRIs*

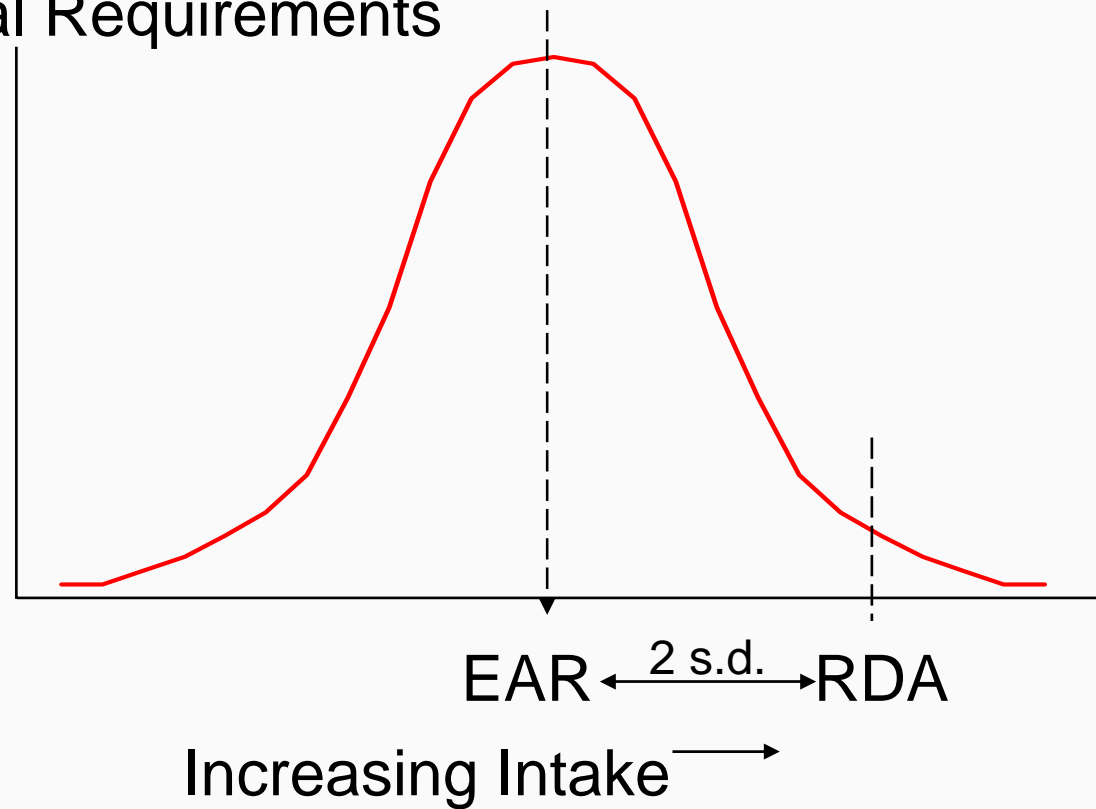
- Observed intakes in healthy populations
- Epidemiological observations
- Balance studies
- Depletion/repletion studies
- Animal experiments
- Biochemical measurements

# *Essential Nutrients*

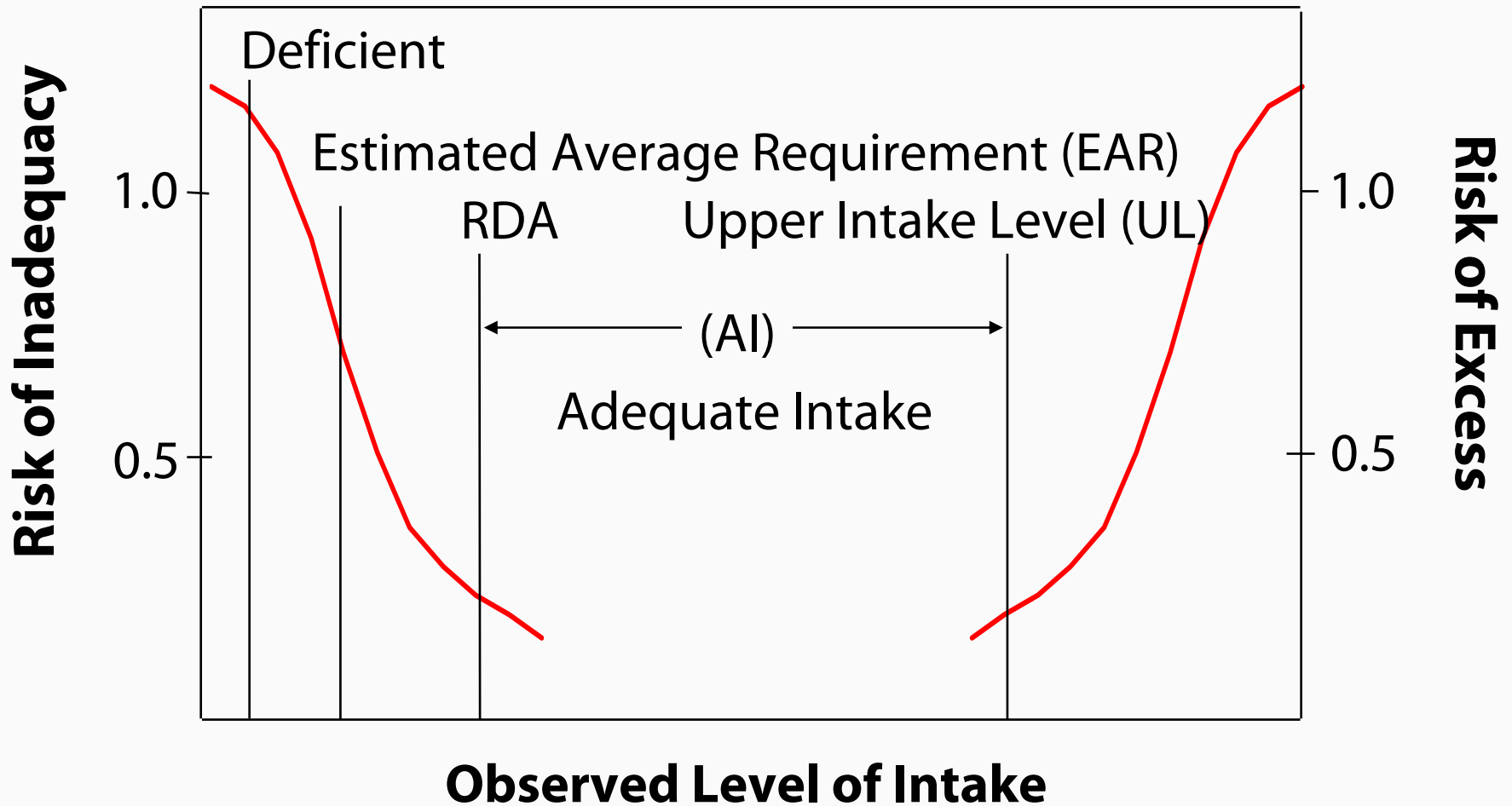
- Chemical substances found in food
- Necessary for life, growth, and tissue repair
- Cannot be synthesized

# Dietary Reference Intakes

Frequency Distribution  
of Individual Requirements



# Safe Intake Range





# *Recommended Dietary Allowance*

- Sufficient to meet the daily nutrient requirements of most individuals in a specific life stage and gender group
- Set at a level that is at the top two to three percent of the requirement distribution
- Intended to serve as a goal for daily intake by individuals

## *Estimated Average Requirement*

- Average requirement for healthy individuals in which functional/clinical assessment conducted and adequacy determined
- Limited in number due to few human studies
- Half of subjects' needs met at this level (50% of subjects would not have their needs met)

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



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## *Section C*

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AI, UL, and Dietary Guidelines

# *Adequate Intake*

- Based on observed or experimentally determined approximations of the nutrient intake by a defined population or subgroup that appears to sustain a defined nutritional state
- Can be used as a guide to nutrient intake for the individual

# *Adequate Intake*

- The AI may exceed the RDA for the same specified endpoint of nutritional adequacy, if the latter could be determined
- The excess of an AI, relative to a true EAR or RDA, is likely to differ among nutrients, population groups, and distinct sociocultural settings

# *Adequate Intake*

- The AI may be used as a goal for nutrient intake for the individual (it is derived from intakes that appear to sustain a defined nutritional state)

# *Comparison of the AI with the RDA*

## ■ **Similarities**

- AIs and RDAs for individuals

## ■ **Differences**

- Less certainty about AI values (greater degree of judgment)
- May deviate significantly from and exceed RDA, it if could be determined
- Use with greater care



## *Tolerable Upper Intake Level*

- Highest level of daily nutrient intake that is likely to pose no risks of adverse health effects to almost all individuals in the general population
- Determined by risk assessment methods
- Not intended to be a recommended level of intake (no evidence of benefit for healthy individuals in consuming nutrients above the RDA or AI)

## ■ **Dietary Guidelines**

- Qualitative advice to the public about diet and chronic disease prevention (e.g., the Food Pyramid)

## ■ **DRIs**

- Quantitative advice to professionals about amounts of nutrients found to be of benefit

# *Dietary Guidelines*

- USDA, FDA, DGC, NIH, professional organizations
- National nutritional and health goals
- Implementation of DRI by food assistance programs
- Nutrition education
- Food industry regulation

# *Criteria for Diet-Disease Relationships*

- Strength of association
- Dose-response relationship
- Temporally correct association
- Consistency of association
- Specificity of association
- Biological plausibility

# *Pharmacological Effects of Nutrients*

- Doses for therapeutic effect exceed levels in food
- Pharmacological action different from physiological function
- Chemical analogs more effective therapeutically but have no nutrient activity