Nutrition Assessment Module

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References: Lee RD, Nieman DC. Nutritional assessment. 6th ed. New York, NY: McGraw-Hill; 2013.

Lecture Title: Standards for Nutrient Intake: Understanding and Applying the DRIs

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Foundations and the DRI Framework

I. Introduction to Nutrient Standards

Nutritional assessment is a fundamental element of healthcare used to identify persons at nutritional risk, reduce chronic disease risk, and manage healthcare costs. Standards for nutrient intake provide the quantitative standards necessary to evaluate the adequacy of food and nutrient intake for both individuals and groups. Historically, the motivation for establishing these standards was to prevent deficiency diseases such as scurvy (vitamin C deficiency) and pellagra (vitamin B3 deficiency). However, modern standards have shifted focus toward reducing the risk of chronic non-communicable diseases such as cardiovascular disease, type 2 diabetes, and cancer.

II. The Evolution of Standards

• **Early Observational Standards:** In the late 19th century, researchers like Carl von Voit and Wilbur Olin Atwater based recommendations on observed intakes of healthy laborers rather than measured physiological needs. Earlier, Islamic scholars such as Ibn Sina had already emphasized balanced diets, moderation, and the relationship between food and health, reflecting an early conceptual foundation for nutrition standards.

• **Recommended Dietary Allowances (RDAs):** First established in 1941, the original RDAs focused primarily on preventing micronutrient deficiencies during wartime. Similarly, the teachings of Prophet Muhammad (PBUH) promoted moderation, portion control, and healthy eating habits, aligning with the preventive focus of early nutritional guidelines.

• **The Transition to DRIs:** By the 1990s, the RDAs were seen as limited because they did not address chronic disease prevention, the needs of older adults, or components like fiber and phytochemicals. This led to the development of the Dietary Reference Intakes (DRIs), a collaborative effort between the U.S. and Canada. This modern shift toward comprehensive health mirrors earlier contributions of scholars like Al-Razi, who linked diet with disease prevention and overall well-being.

III. Defining the DRI Framework

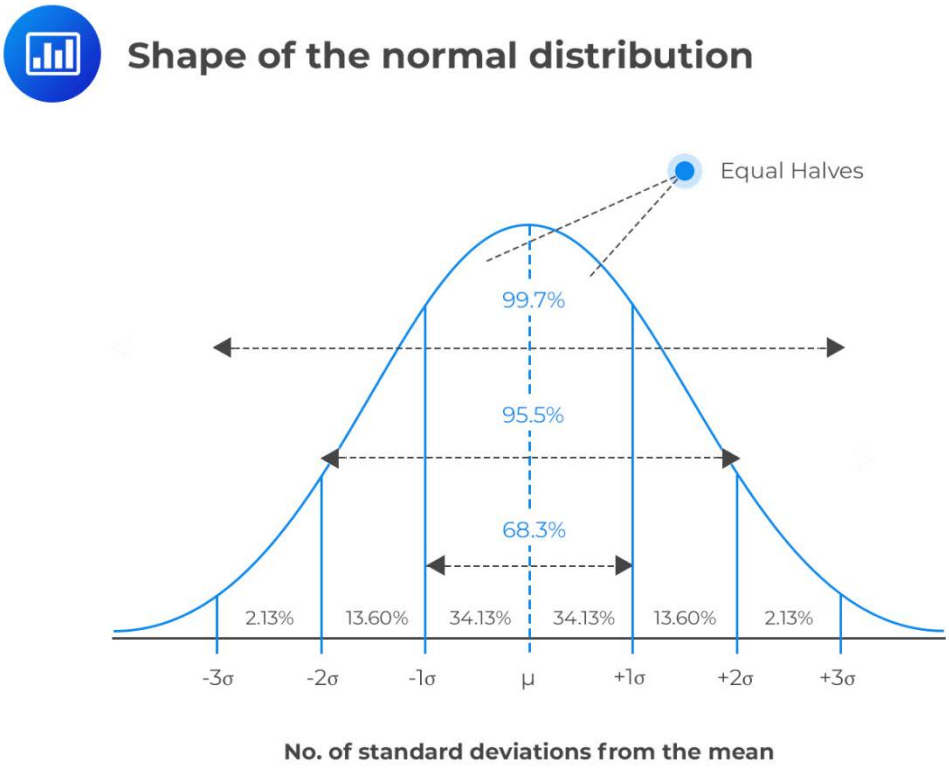
The DRIs are a set of at least four nutrient-based reference values used for planning and assessing diets for apparently healthy people.

1. ***Estimated Average Requirement (EAR):*** represents the median population requirement. It is the daily intake value estimated to meet the requirement of 50% of healthy individuals in a specific life stage and gender group.
2. ***Recommended Dietary Allowance (RDA):*** It is set higher to cover nearly all individuals in a group. The average daily intake level is sufficient to meet the nutrient requirements of nearly all (97% to 98%) healthy individuals in a group.
3. ***Adequate Intake (AI):*** Used when scientific evidence is insufficient to calculate an EAR. It is used as an estimated adequate intake based on observed data. It is based on observed or experimentally determined approximations of nutrient intake by a group of healthy people.
4. ***Tolerable Upper Intake Level (UL):*** The highest level of daily nutrient intake unlikely to cause harmful health effects to almost all individuals.

Hour 2: Application and Assessment of Diet Adequacy

IV. The Biological Basis: EAR and RDA

The Estimated Average Requirement (EAR) is the cornerstone for developing dietary reference values. It represents the average daily nutrient intake level estimated to meet the requirements of 50% of healthy individuals in a specific population group. To determine the EAR, scientists first define a criterion of adequacy, such as preventing a deficiency disease, maintaining normal physiological function, or supporting a specific metabolic process.



However, nutrient requirements are not identical across individuals. They vary due to biological differences such as age, sex, genetics, and health status. To account for this variability, nutrient requirements within a population are assumed to follow a normal (Gaussian) distribution[1], often illustrated as a bell-shaped curve. In this distribution, most individuals cluster around the average requirement (EAR), with fewer individuals having much lower or much higher needs.

Based on this distribution, the RDA is calculated to cover nearly all individuals in the population. If the standard deviation[2] (SD) of the EAR is known, the RDA is set at two standard deviations above the EAR:

- RDA = EAR + 2 SD

[1] Normal distribution: A symmetrical, bell-shaped distribution in which most values cluster around the mean, and fewer values occur as you move away from the center.
[2] Standard deviation: A measure of how spread out the values are around the average (mean). A small SD indicates that most values are close to the mean, while a large SD indicates greater variability.

This level corresponds to meeting the needs of approximately 97–98% of the population.

In situations where there is insufficient data to determine the SD, a coefficient of variation[3] (CV) of 10% is typically assumed. Under this assumption, the RDA is estimated as:

- RDA = 1.2 × EAR

V. Assessing Individuals vs. Groups

As future dietitians, you must distinguish between using DRIs for an individual client versus a population.

- **Individual Assessment:**
  - If usual intake is ≥ RDA or AI, the intake is likely adequate. Example:
  - The RDA for vitamin C for adult women is about 75 mg/day.
    - Example: A woman consumes 90 mg/day from fruits and vegetables. Since her intake is above the RDA, her intake is very likely ***adequate***.
  - If usual intake is < EAR, there is a high likelihood the intake is inadequate.
    - Example: The EAR for iron for adult women is about 8 mg/day.
    - A woman consumes 6 mg/day. Since her intake is below the EAR, there is a high likelihood that her intake is ***inadequate***.
  - If intake is between the EAR and RDA, the likelihood of inadequacy is difficult to determine, requiring clinical or biochemical markers for confirmation.
    - Example: EAR for calcium = 800 mg/day. RDA for calcium = 1000 mg/day. A man consumes 900 mg/day. His intake is between EAR and RDA, so: It may be adequate for him, but not certain without further assessment (e.g., serum calcium, bone density, clinical evaluation).
- **Group Assessment:**
  - The RDA should NOT be used to assess the prevalence of inadequacy in a group.
  - Instead, use the EAR cutpoint approach, which estimates the percentage of group members whose usual intakes are less than the EAR.

VI. Energy and Macronutrient Standards

[3] A relative measure of variability expressed as a percentage of the mean, calculated as:
CV = (SD ÷ Mean) × 100. It allows comparison of variability between datasets with different units or scales.

Unlike vitamins and minerals, energy has its own specific standard to prevent overconsumption and obesity.

- ***Estimated Energy Requirement (EER):*** The average dietary energy intake predicted to maintain energy balance in a healthy adult based on age, gender, weight, height, and physical activity. There is no RDA or UL for energy, as intakes above the EER would lead to unhealthy weight gain.
- ***Acceptable Macronutrient Distribution Ranges (AMDRs):*** These provide guidance on the percentage of total energy that should come from fat (20–35% for adults), carbohydrate (45–65%), and protein (10–35%) to decrease chronic disease risk.

VII. Practical Summary for Dietetic Practice

- DRIs are for healthy populations: Clinical judgment is required when applying them to those who are ill or injured, as requirements may change due to disease stress.
- Dietary Quality Indices: Tools like the Healthy Eating Index (HEI) or Diet Quality Index (DQI) can further help assess how well a diet adheres to federal guidelines like MyPlate and the Dietary Guidelines for Americans.
- Multiple Methods: A thorough assessment should never rely on DRIs alone; it must include anthropometric, biochemical, and clinical data.

Assessment Activity: Using the provided EAR and RDA tables, students will now evaluate a 24-hour recall of a hypothetical patient to determine the probability of nutrient inadequacy. See the Activity Sheet in the Next Page.

End of module 3…

Example 1: Adult Female, 30 years old

24-hour Recall:

- Breakfast: 1 bowl of oatmeal (40 g) with 200 mL milk, 1 banana
- Lunch: Grilled chicken breast (150 g), 1 cup cooked rice (200 g), steamed broccoli (100 g)
- Snack: 1 small apple, 10 almonds
- Dinner: Baked salmon (120 g), 1 medium potato, 1 cup green beans

Key Nutrients for Evaluation:

- Protein, Iron, Calcium, Vitamin C, Vitamin A

Task for Students:
Compare intake to EAR/RDA for a 30-year-old female. Determine which nutrients may be inadequate and estimate the probability of inadequacy.

Example 2: Adult Male, 45 years old

24-hour Recall:

- Breakfast: 2 slices whole-grain toast with peanut butter, 1 boiled egg, black coffee
- Lunch: Beef burger (150 g), lettuce, tomato, 1 medium baked potato
- Snack: Yogurt (150 g) with honey, a handful of walnuts
- Dinner: Spaghetti (200 g) with tomato sauce, 1 slice whole-grain bread

Key Nutrients for Evaluation:

- Protein, Zinc, Folate, Fiber, Vitamin D

Task for Students:
Compare intake to EAR/RDA for a 45-year-old male. Identify nutrients at risk of inadequacy.

Example 3: Adolescent Female, 16 years old

24-hour Recall:

- Breakfast: 1 glass of orange juice, 1 bagel with cream cheese
- Lunch: Tuna sandwich on whole-grain bread, carrot sticks
- Snack: Chocolate bar, 1 cup milk
- Dinner: Chicken stir-fry (100 g chicken, vegetables, 150 g rice)

Key Nutrients for Evaluation:

- Iron, Calcium, Vitamin B12, Vitamin C, Vitamin D

Task for Students:
Evaluate the likelihood of nutrient inadequacy, considering adolescent growth needs.

Example 4: Older Adult Male, 70 years old

24-hour Recall:

- Breakfast: Porridge (50 g oats) with 150 mL milk, 1 kiwi
- Lunch: Lentil soup (250 mL), 1 slice whole-grain bread, 50 g cheese
- Snack: Handful of roasted peanuts, 1 pear
- Dinner: Grilled trout (100 g), boiled vegetables, mashed potato (150 g)

Key Nutrients for Evaluation:

- Protein, Vitamin B12, Calcium, Magnesium, Potassium

Task for Students:
Assess nutrient intake versus EAR/RDA for older adults. Identify nutrients most likely to be inadequate and explain reasoning.

Each example allows students to:

1. Convert foods to nutrient amounts.
2. Compare with EAR/RDA.
3. Estimate probability of inadequacy (e.g., "intake < EAR → high probability of inadequacy").
4. Provide a brief interpretation or recommendation.

Nutrient Evaluation Table Template

Meal	Food Item	Amount	Energy (kcal)	Protein (g)	Iron (mg)	Calcium (mg)	Vitamin C (mg)	Vitamin A (µg)	Notes / Adequacy
Breakfast									
Snack									
Lunch									
Snack									
Dinner									
Total Intake									
EAR / RDA									
Adequacy									

Instructions for Students:

1. Fill in the “Food Item” and “Amount” columns from the 24-hour recall.
2. Use a food composition database (or provided nutrient tables) to calculate the nutrient values.
3. Compare totals with the EAR/RDA for the specific age/sex.
4. Indicate adequacy:
    - **Adequate** → meets or exceeds RDA
    - **Possible inadequacy** → below EAR
    - **High risk of inadequacy** → significantly below EAR

Example of a Calculated Answer for Hypothetical Cases

Case #:

Nutrient	Total Intake	EAR	RDA	Adequacy
Protein (g)				
Iron (mg)				
Calcium (mg)				
Vitamin C (mg)				
Vitamin A (µg)				

Interpretation: