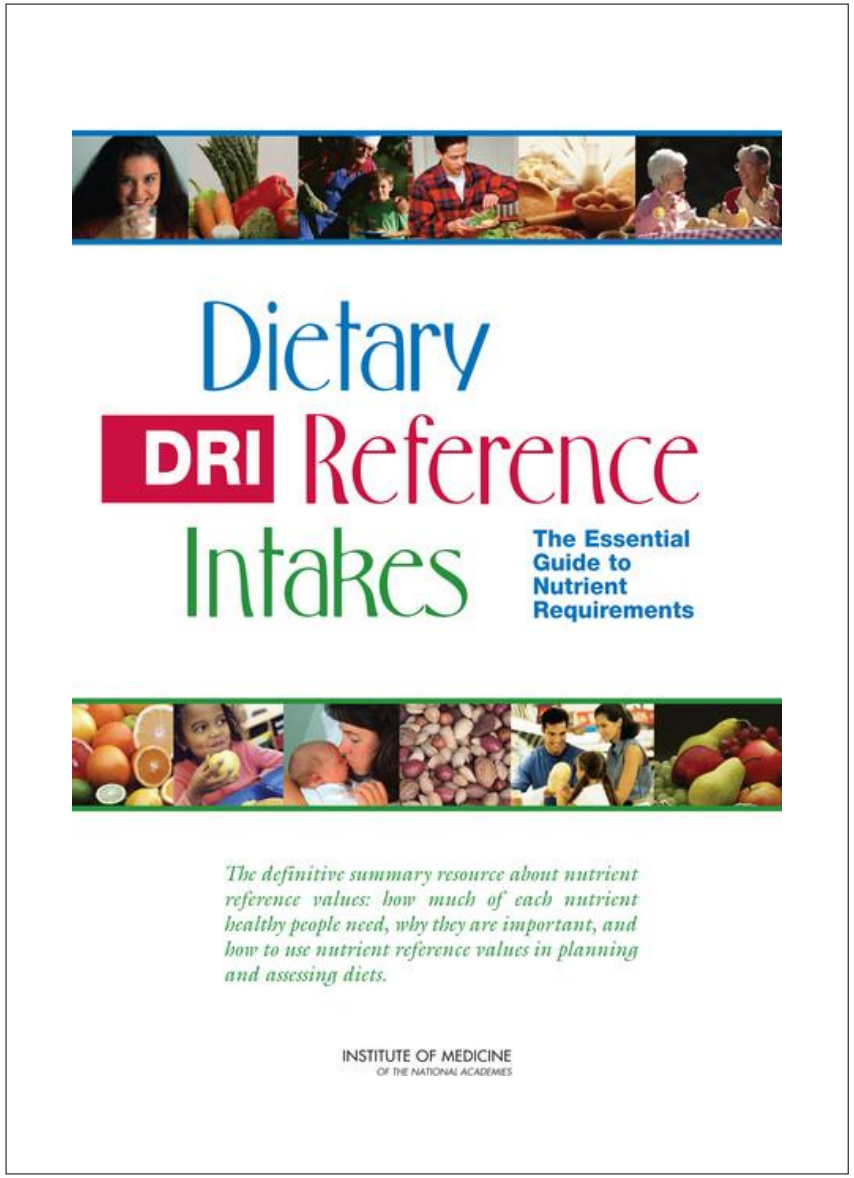
Nutrition Guidelines:

Applying the Science of Nutrition

Learning Objectives

1. Differentiate between the food-based approach and nutrient-based approach used in nutrition recommendations
2. Compare and contrast food guides from Canada and other countries
3. Discuss the Dietary Reference Intakes (DRI): EAR & RDA, AI, UL, AMDR
4. Define estimated energy requirement (EER) and describe EER and its relation to energy balance



Dietary reference intakes: EAR & RDA, EAR cutpoint, AI, UL

https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/dietary-reference-intakes/tables.html#abb

2.1 Nutrition Recommendations for the Canadian Diet

Nutrient-based approach

- How much of a nutrient is required to maintain health?

Food-based approach

- Dietary pattern
  - Types and amounts of foods to maintain health

Recommendations are regularly updated.

2.1Nutrition Recommendations for the Canadian Diet

History

- First recommendations in Canada 1939, 1943
- Recommended Nutrient Intakes (RNI)

Today

- Dietary Reference Intake (DRIs)
- Determined by the Institute of Medicine (IOM) by Canadian and American scientists beginning in the 1990's and continuing today

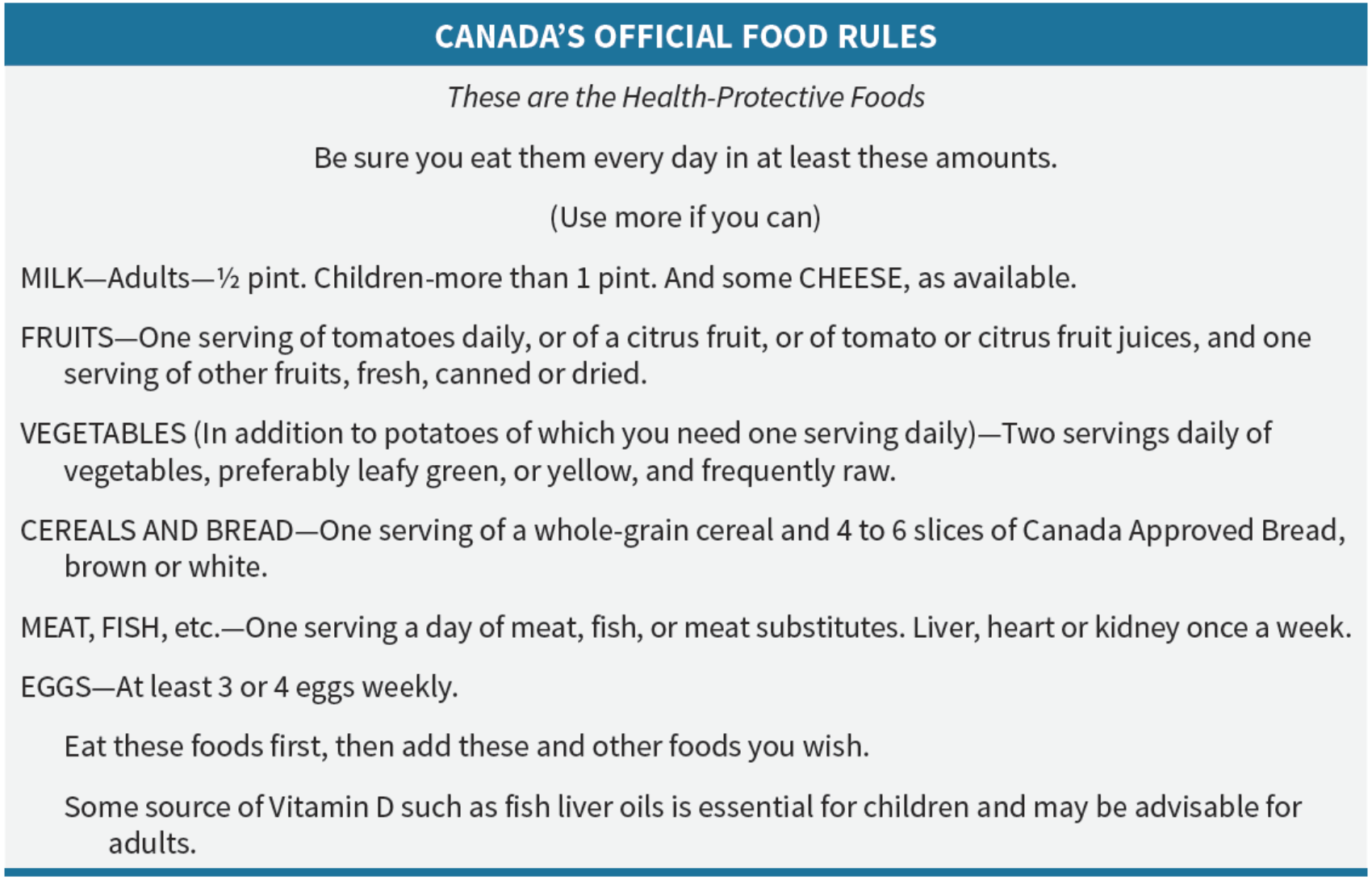
Nutrient-based approach

Chronology of nutrient standards and DRI development in Canada

Year(s)	Start of nutrient standards
1939	Canadian Council on Nutrition publishes first dietary standards in Canada.
1941	First edition of the Recommended Dietary Allowances (RDAs) published in the United States.
1942	Canadian Council on Nutrition adopts RDAs for the sake of consistency.
1945	Canadian Council on Nutrition advises discontinuing use of RDAs in Canada. A new Canadian standard is released.
1948-1990	Canadian standards periodically updated and released, based on cumulative scientific data. Term "recommended nutrient intakes" is used for the first time in the 1983 version of Canadian standards.
1989	10th edition of the RDAs published in the United States.
1990	Health Canada (formerly Health and Welfare Canada) publishes revised recommended nutrient intakes (RNIs).

https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/dietary-reference-intakes/development-dietary-reference-intakes.html

Canada's Official Food Rules 1942: Fig 2.2



CANADA'S OFFICIAL FOOD RULES

These are the Health-Protective Foods

Be sure you eat them every day in at least these amounts.

(Use more if you can)

MILK—Adults—½ pint. Children-more than 1 pint. And some CHEESE, as available.

FRUITS—One serving of tomatoes daily, or of a citrus fruit, or of tomato or citrus fruit juices, and one serving of other fruits, fresh, canned or dried.

VEGETABLES (In addition to potatoes of which you need one serving daily)—Two servings daily of vegetables, preferably leafy green, or yellow, and frequently raw.

CEREALS AND BREAD—One serving of a whole-grain cereal and 4 to 6 slices of Canada Approved Bread, brown or white.

MEAT, FISH, etc.—One serving a day of meat, fish, or meat substitutes. Liver, heart or kidney once a week.

EGGS—At least 3 or 4 eggs weekly.

Eat these foods first, then add these and other foods you wish.

Some source of Vitamin D such as fish liver oils is essential for children and may be advisable for adults.

FIGURE 2.2 Canada's Official Food Rules were developed in 1942 to promote nutritious eating during difficult wartime rationing.

Food-based approach

Advances in Nutrition
American Society for Nutrition

History of Nutrition: The Long Road Leading to the Dietary Reference Intakes for the United States and Canada[1,2,3]

Suzanne P Murphy, Allison A Yates, [...], and Johanna Dwyer

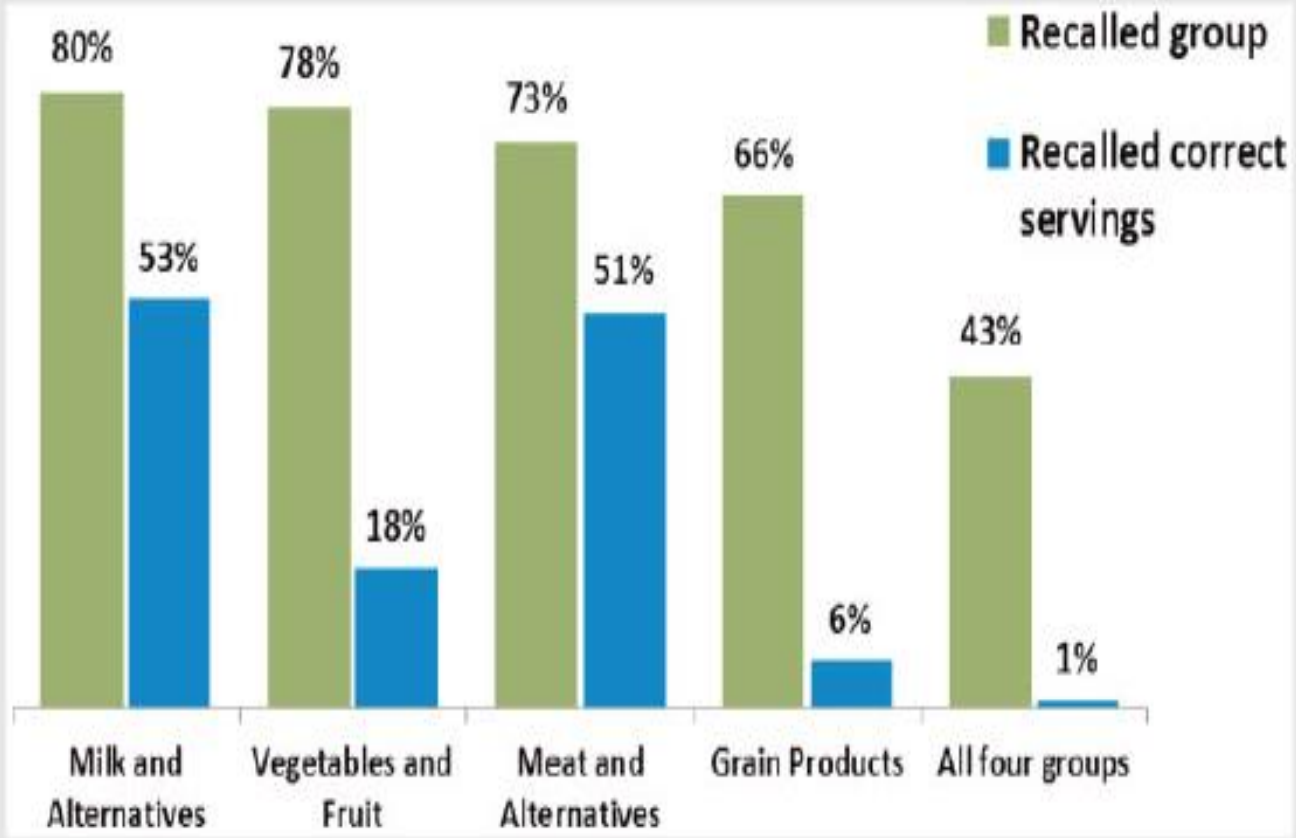
Additional article information

Abstract

The Dietary Reference Intakes (DRIs) are reference values to guide the planning and assessing of nutrient intakes in the United States and Canada. The DRI framework was conceptualized in 1994, and the first reports were issued from 1997–2004, based on work by expert panels and subcommittees under the guidance of the Food and Nutrition Board of the Institute of Medicine. Numerous conventions, challenges, and controversies were encountered during the process of defining and setting the DRIs, including the definition of the framework, the use of chronic disease endpoints, lack of data on requirements for children and youth, and methods for addressing nonessential bioactive substances with potential health benefits. DRIs may be used to plan and assess the nutrient intakes of

https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/dietary-reference-intakes/development-dietary-reference-intakes.html

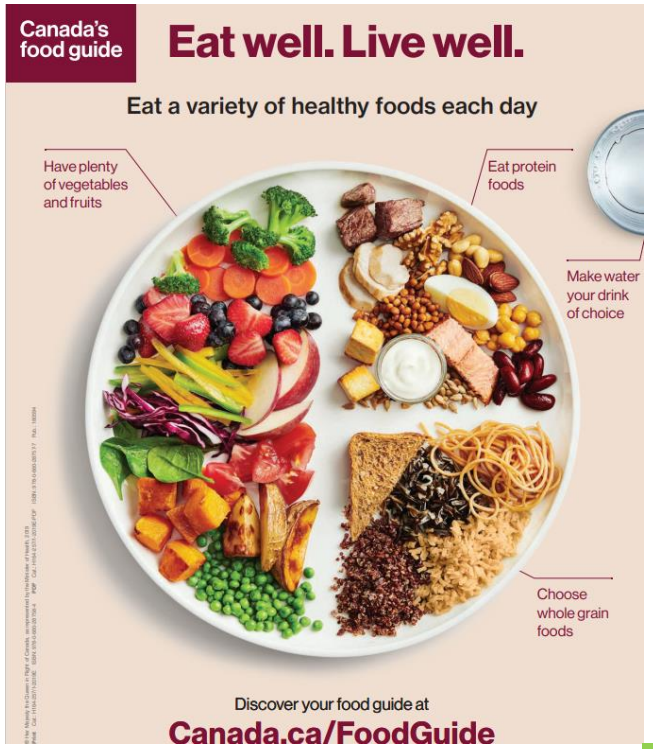
Figure 1. Respondents who were able to correctly recall each of the food groups[a] and correctly recall how many servings of each food group should be consumed daily[b] (n = 1,048).

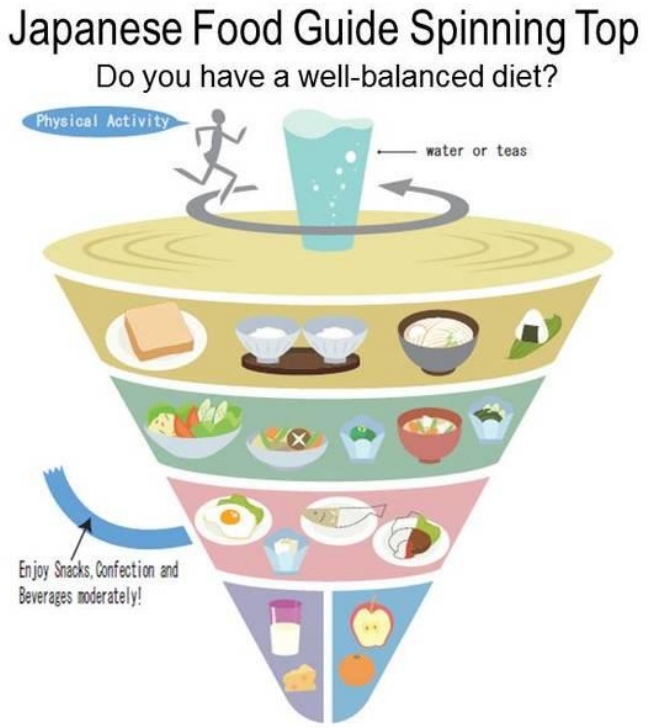


[a]Responses for Vegetables and Fruit were defined as correct if the participant described "fruit" and "vegetables" either together or separately. Correct responses for Grain Products were "grains", "whole grains", or "cereals". For the Milk and Alternatives group, correct responses included "milk" or "dairy" only. For Meat and Alternatives, correct responses were awarded for "meat" only.

[b]Correct responses for servings of each food group: Vegetables and Fruit, 7–10 servings; Grain Products, 6–8 servings; Milk and Alternatives, 2–3 servings; and Meat and Alternatives, 2–3 servings.

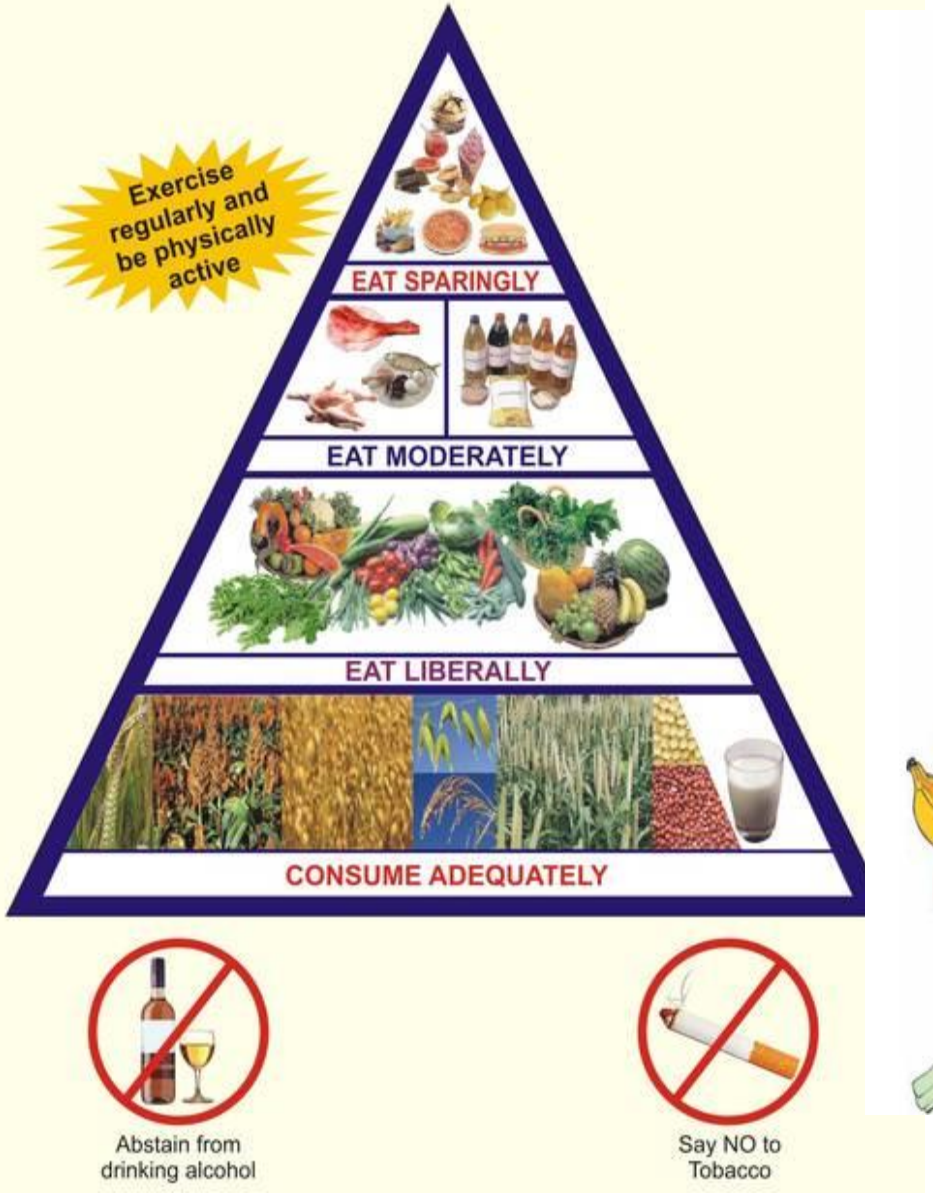
Nutrition recommendations from all around the world



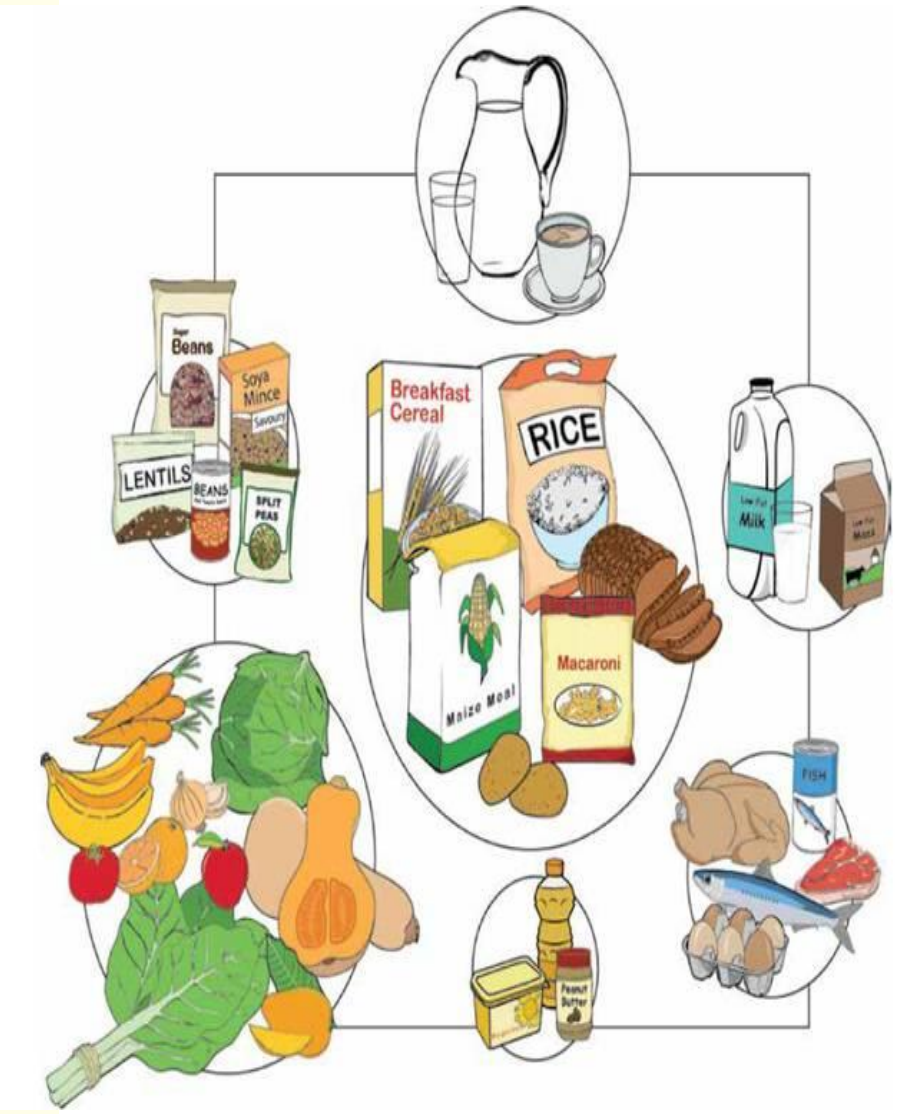


Food-based approach

Ghana



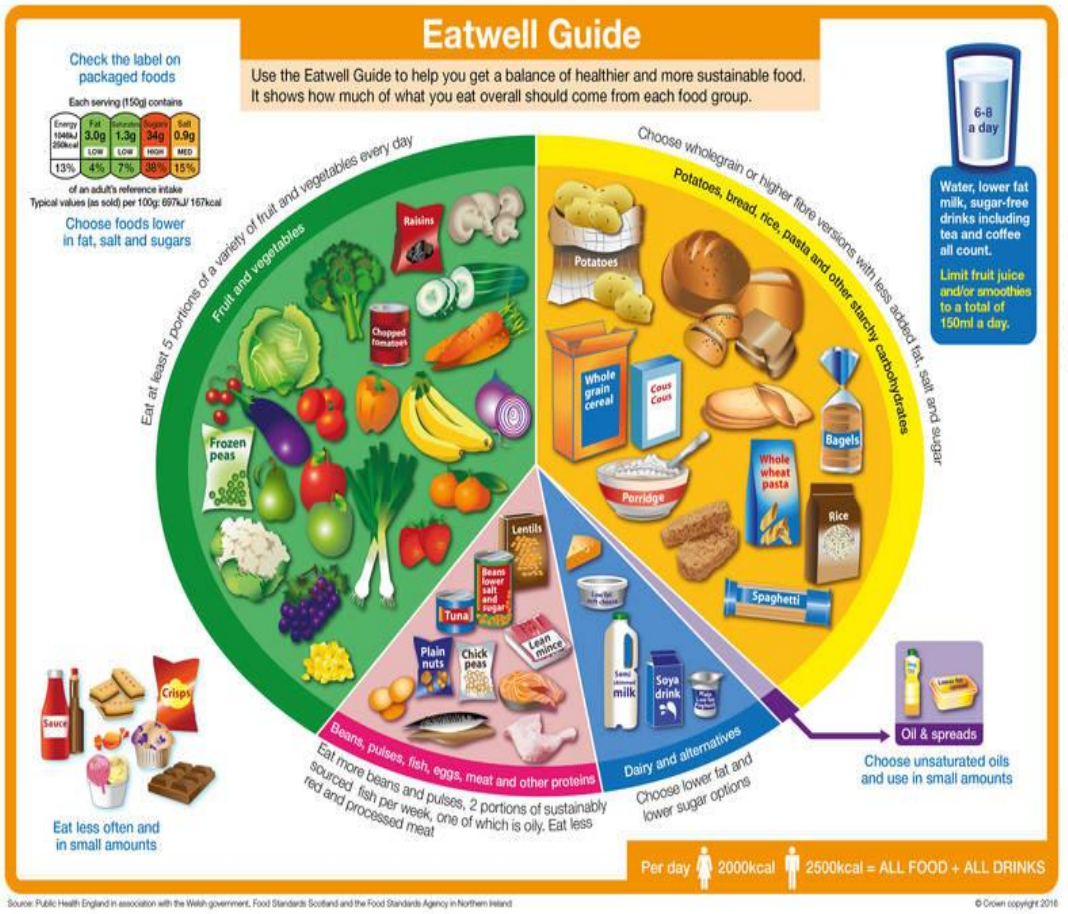
India



South Africa

Food-based approach

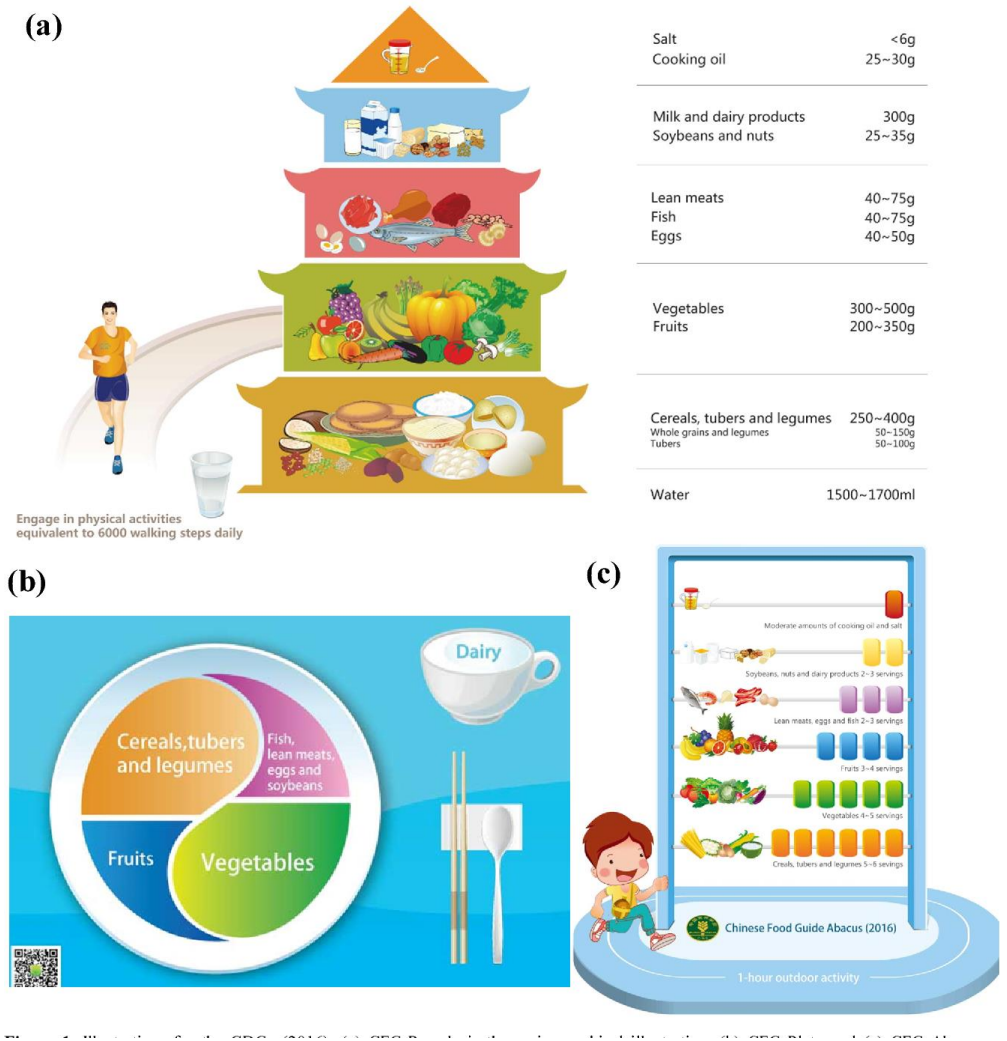
Saudi Arabia



United Kingdom

Mexico

Food-based approach



China

Food-based approach

Food-based dietary guidelines

Background | Regions | Resources | Capacity development

Asia and the Pacific

- Africa
- Asia and the Pacific
- Europe
- Latin America and the Caribbean

This section provides information about food-based dietary guidelines and food guides from Asia and the Pacific.

As of 2020, 18 countries have their own national dietary guidelines. Most countries in the region are facing the double burden of malnutrition and issues of food safety; therefore the need for effectively implementing dietary guidelines is becoming more important than ever.

We invite governments to send us their new or revised food-based dietary guidelines

Filter by country

- select -

Useful links

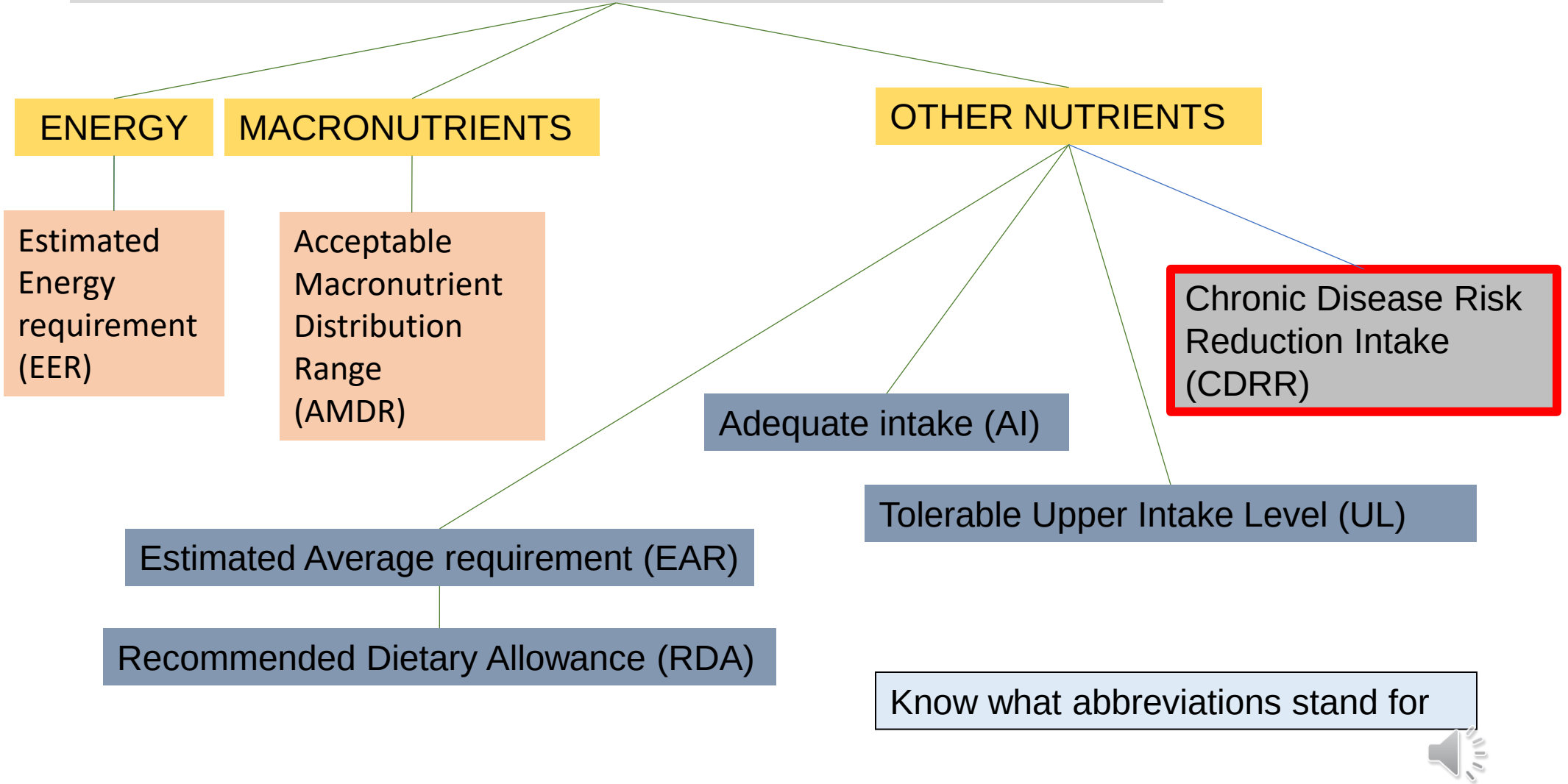
- Regional Consultation on

2.2 Dietary Reference Intakes (DRIs)

- For planning and assessing diets of healthy individuals
- Values for different life stages/ males or females
  - Infants
  - Children
  - Teens
  - Young, middle, older adults
  - Pregnancy/lactation

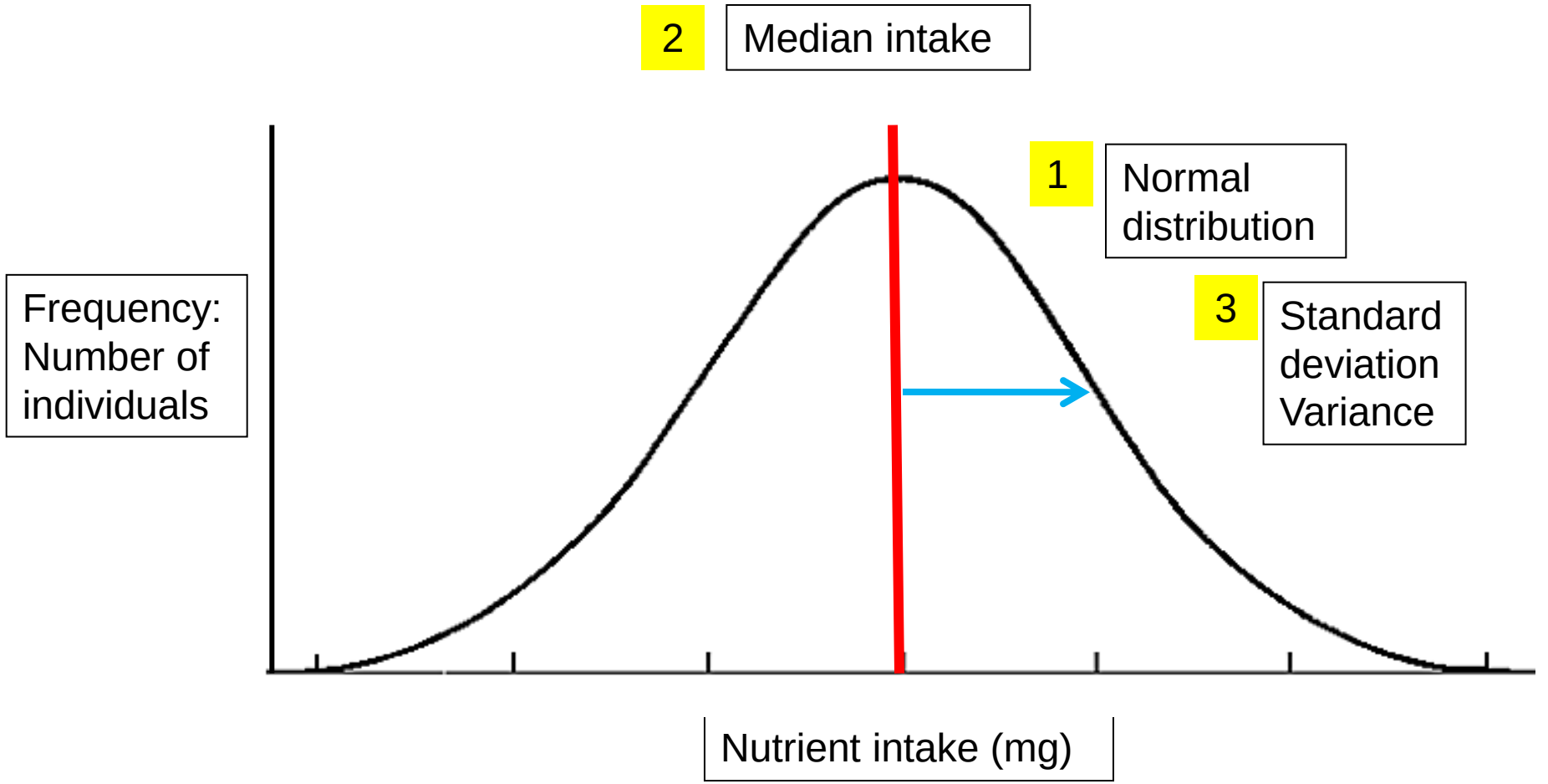
Listed in DRI tables
You will use the DRI tables for part of the **Nutrition Numbers Quiz**

2.2 DIETARY REFERENCE INTAKES (DRI)

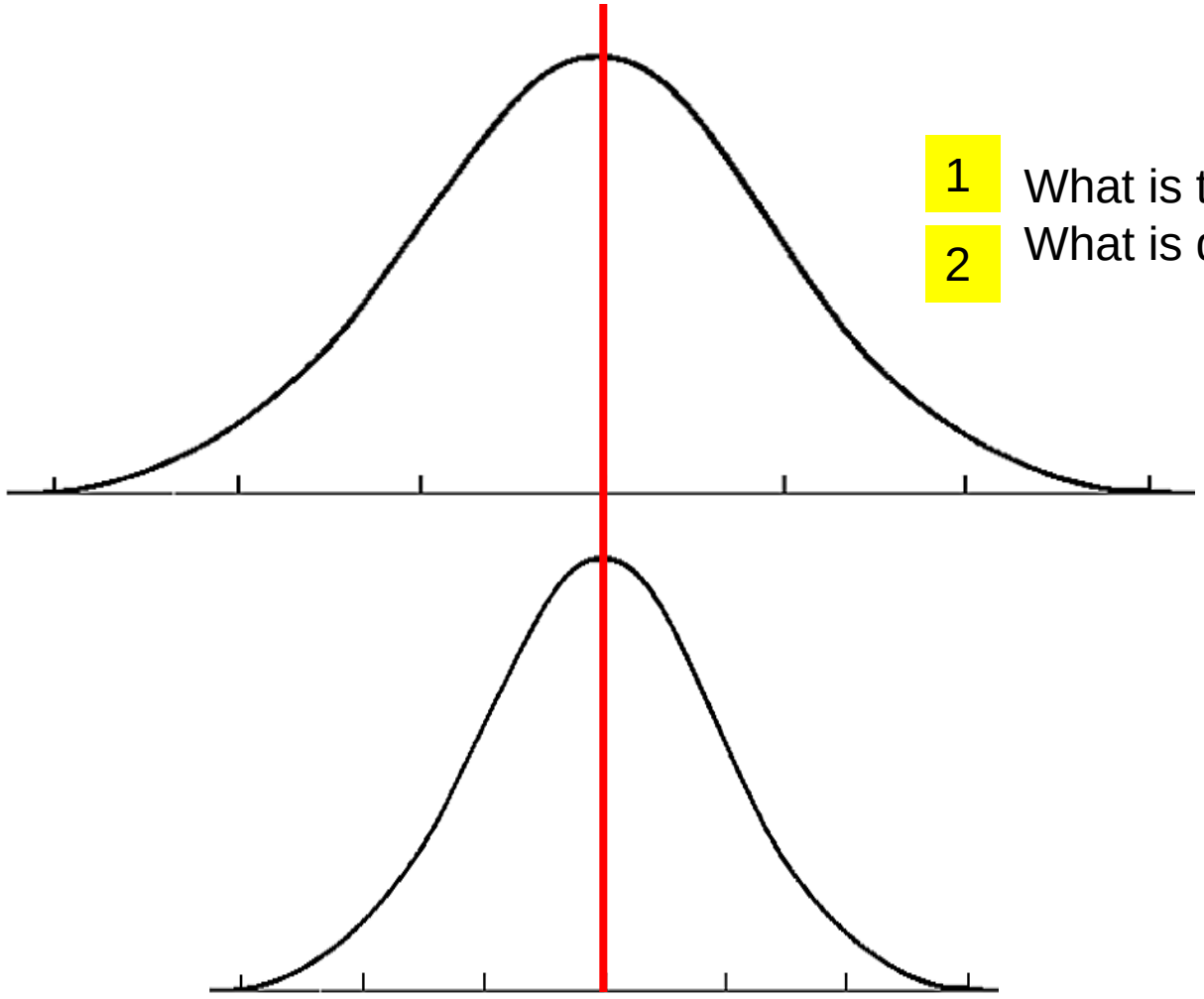


Know what abbreviations stand for

Statistics


2
Median intake
1
Normal distribution
3
Standard deviation
Variance
Frequency: Number of individuals
Nutrient intake (mg)

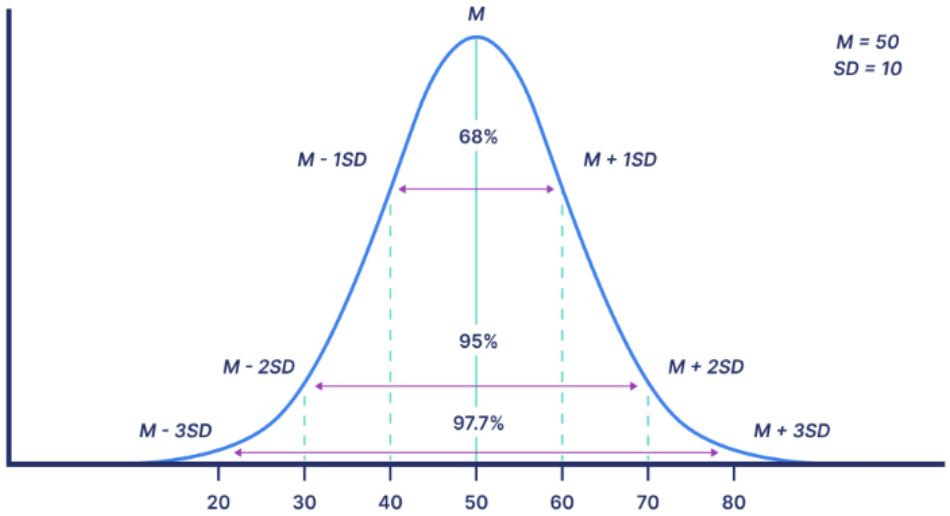
Statistics



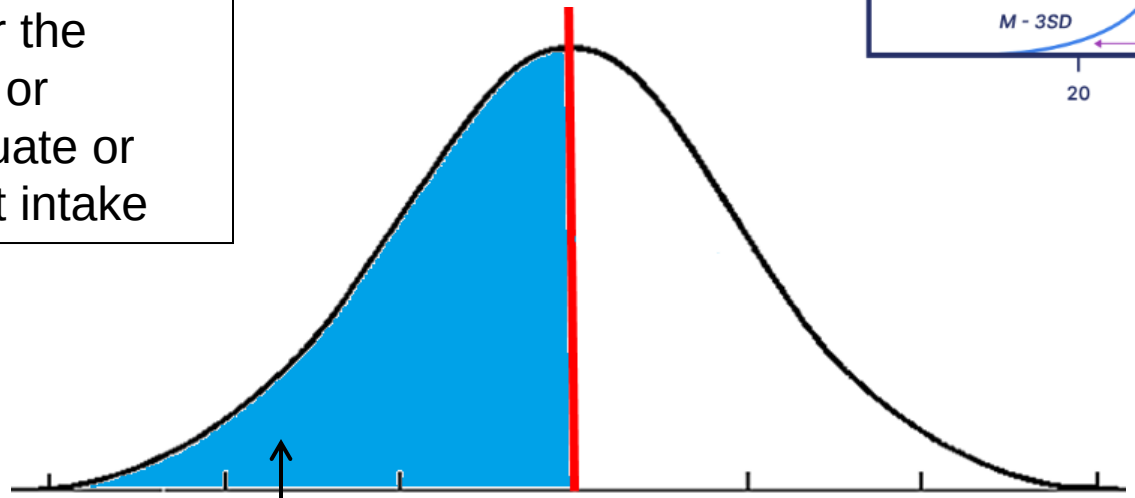
1 What is the same?

2 What is different?

Statistics



Shaded area under the curve →probability or proportion of adequate or inadequate nutrient intake



50% of the curve is shaded → 50% probability or proportion of adequate or inadequate nutrient intake

2.2 Dietary Reference Intakes
Estimated Average Requirement (EAR)

Definition

- Nutrient intake that meets the requirement of 50% of individuals in a group (i.e. sex; age)

How is it used?

- To estimate the probability that an individual's usual intake is meeting his/her requirement
- To estimate what proportion of a group is meeting their requirements

2.2 Dietary Reference Intakes:
Estimated average requirement (EAR)

How is it determined?

- Determine a biochemical criterion that allows you to determine the intake at which an individual's requirement is being met
- Determine the requirement distribution from a sample of the population

2.2 Dietary Reference Intakes: Establishing EARs

- CONSIDER: Hypothetical Vitamin X
  - Physiological criterion:
    - Vitamin X requirement is met when the level of Vitamin X in serum reaches saturation
    - IMPORTANT: not universal criterion for all nutrients
- Conduct a **depletion-repletion experiment** on a population of healthy adults

2.2 Dietary Reference Intakes: Establishing EARs: Hypothetical vitamin X

Depletion

- Fed a vitamin X-free diet
- Levels of vitamin X in blood are tracked
- Eventually levels decline until no vitamin X is detected (i.e. the individual is deficient)

Depletion

Next step?

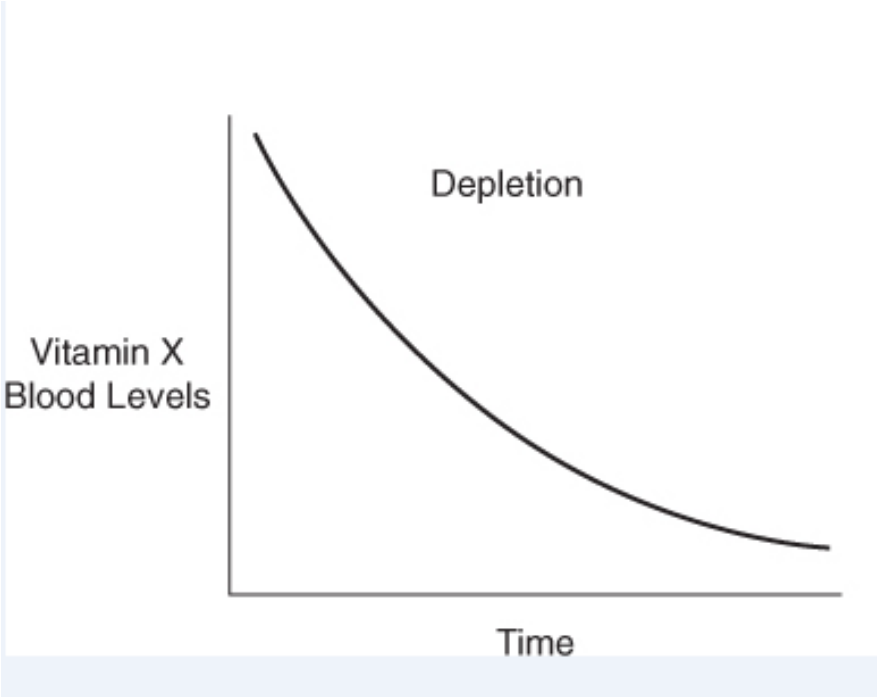


Fig 2.3

2.2 Dietary Reference Intakes:
Hypothetical vitamin X: Next step?

Repletion

- Begin refeeding vitamin X
- What happens?
  - Blood levels of vitamin X begin to rise
  - Eventually each individual reaches an intake at which there is no corresponding rise in blood levels i.e. blood is saturated with vitamin X
  - That Vitamin X intake is the individual's vitamin X requirement

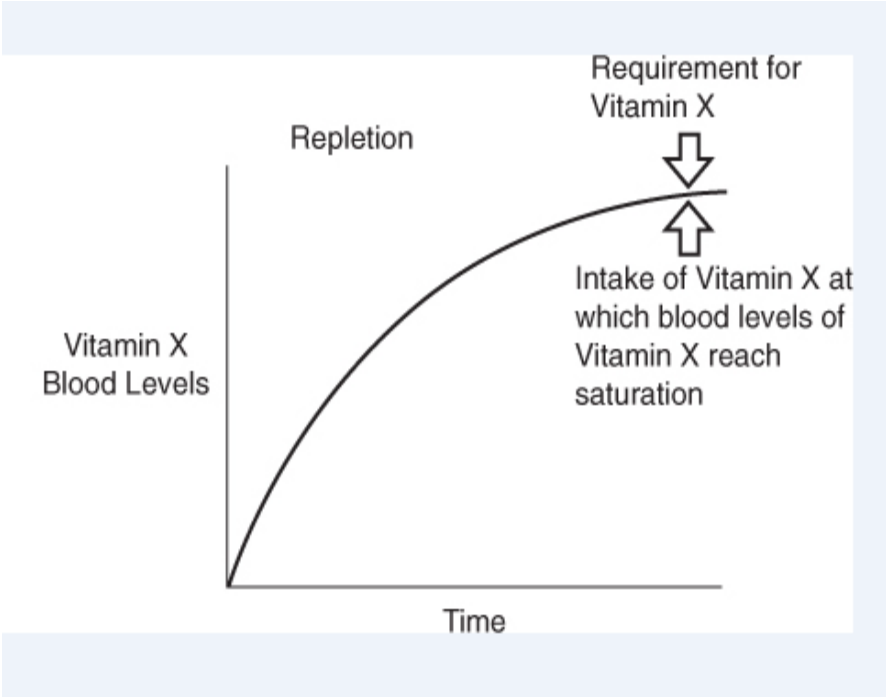
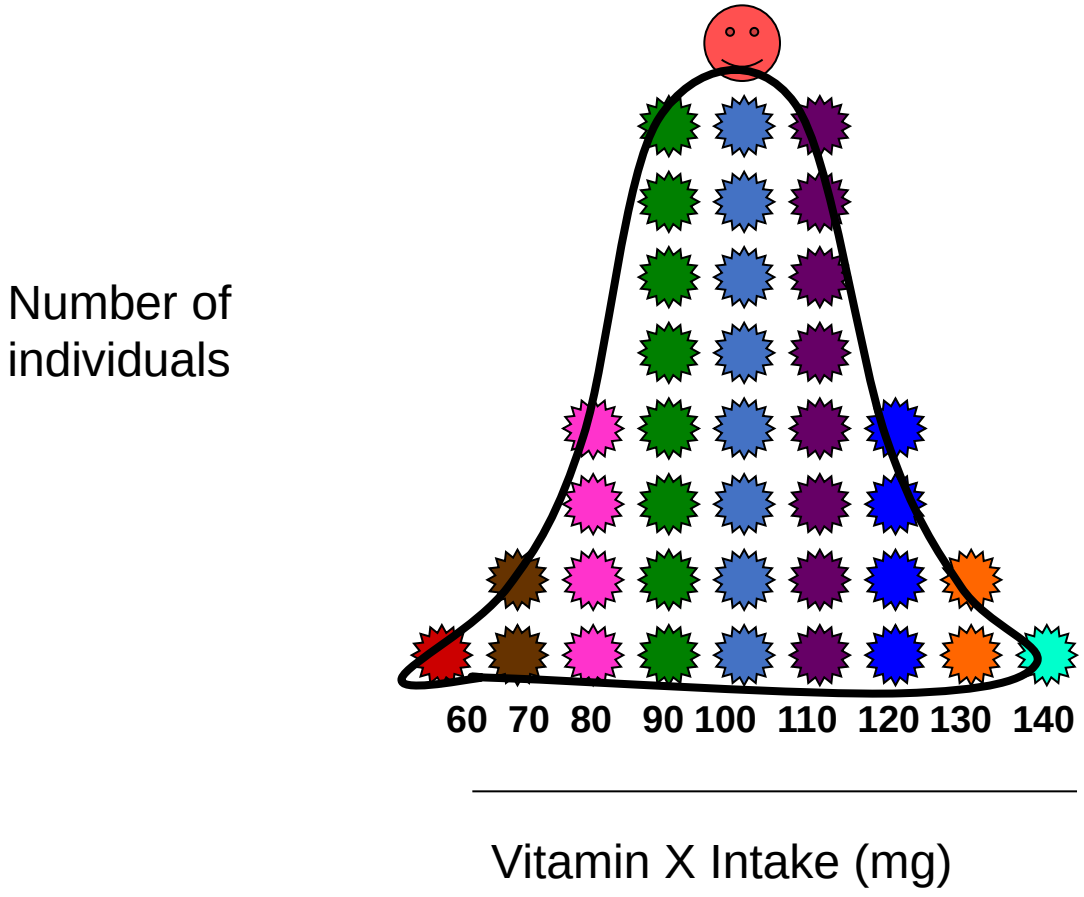


Fig 2.3

Will the requirement be the same for each individual?

2.2 Dietary Reference Intakes: Requirement Distribution for Vitamin X (39 subjects)



Normal distribution

EAR = 100 mg

50% of subjects meet their requirements

See Fig 2.4

2.2 Dietary Reference Intakes:

To understand how requirement distributions are used, it is important to distinguish between REQUIREMENT and INTAKE

Nutrient Requirement

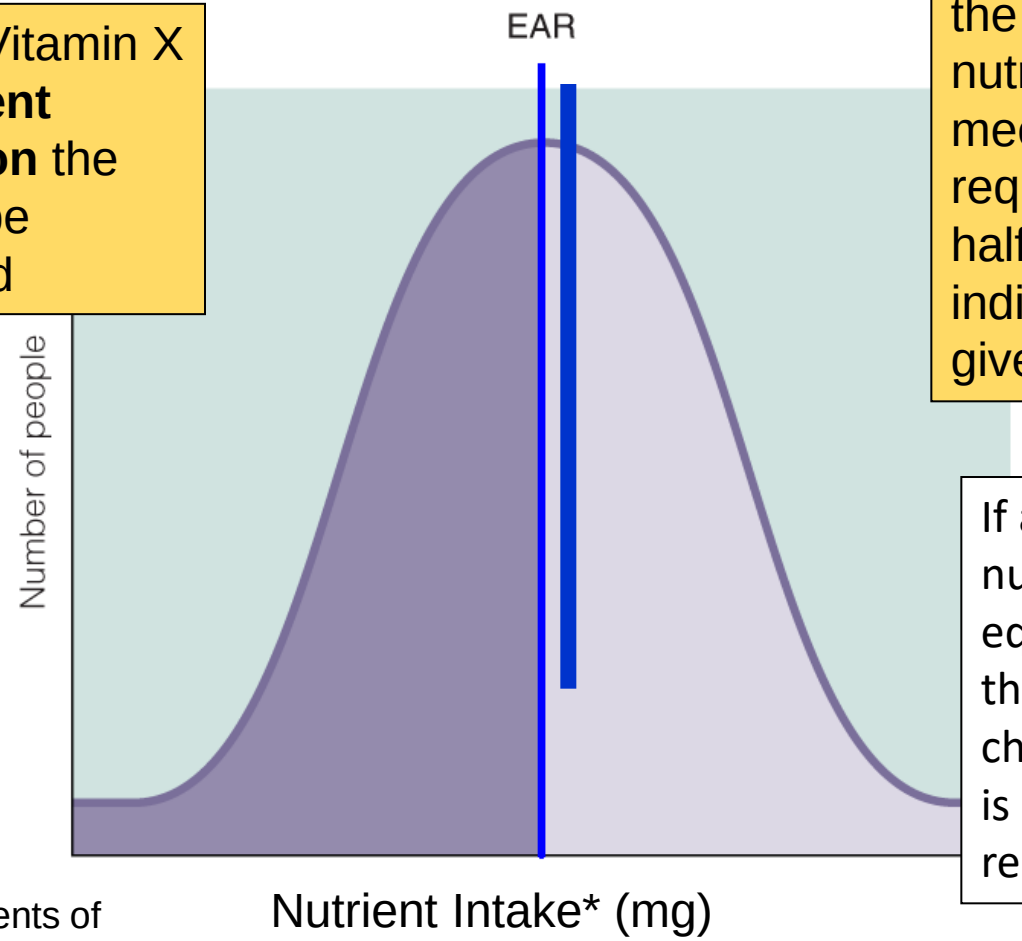
- Experimentally- determined requirement for a nutrient
- Amount required to maintain health

Nutrient Intake

- Amount of nutrient consumed
- Determined by the composition of the diet

2.2 Dietary Reference Intakes EAR (Estimated average requirement)

From the Vitamin X **requirement distribution** the EAR can be determined



EAR represents the average daily nutrient intake that meets the requirements of half the healthy individuals in a given group.

If an individual's nutrient intake is equal to the EAR then there is a 50:50 chance the individual is meeting his/her requirement

Fig 2.4

*that meets the requirements of individuals in the experimental group

2.2 Dietary Reference Intakes:

Determining the probability of meeting requirements from the requirement distribution of a nutrient

What is the probability that A is meeting their requirement?

Assuming the grey area represents about 12% of the total area under the curve, then the probability that A is meeting their requirement is 12%.

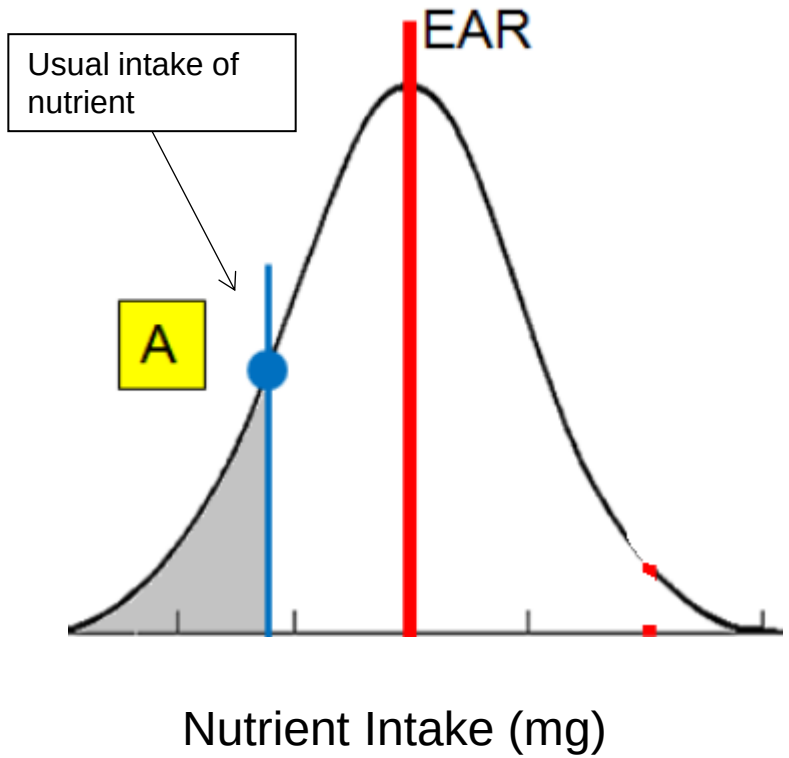


Fig 2.5

Determining the probability of meeting requirements from the requirement distribution of a nutrient

What is the probability that B is meeting their requirement?

Grey area represents 80% of the total area under the curve.

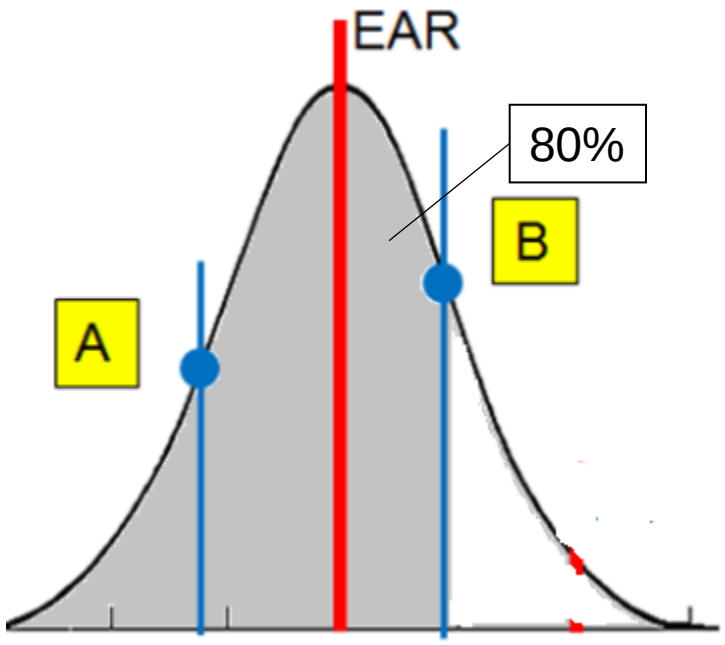


Fig 2.5

2.2 Dietary Reference Intakes:

RDA = Recommended Dietary Allowance: intake that ensures a 98% probability of meeting your requirement

How is the RDA used?

As a goal for an individual's usual intake, because it is almost certainly adequate

RDA = EAR + 2 Standard Deviations

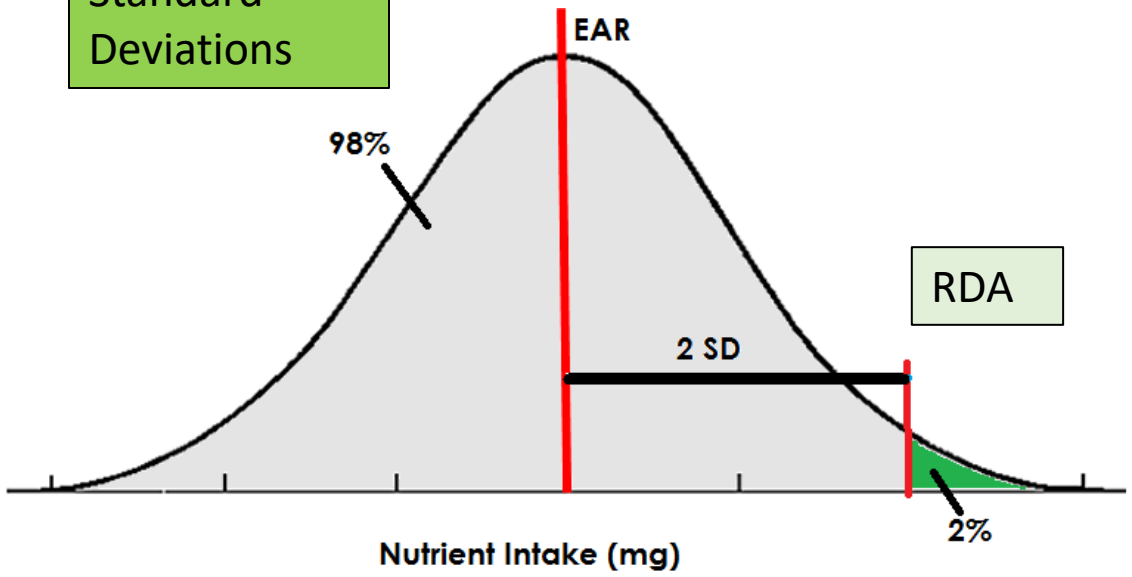
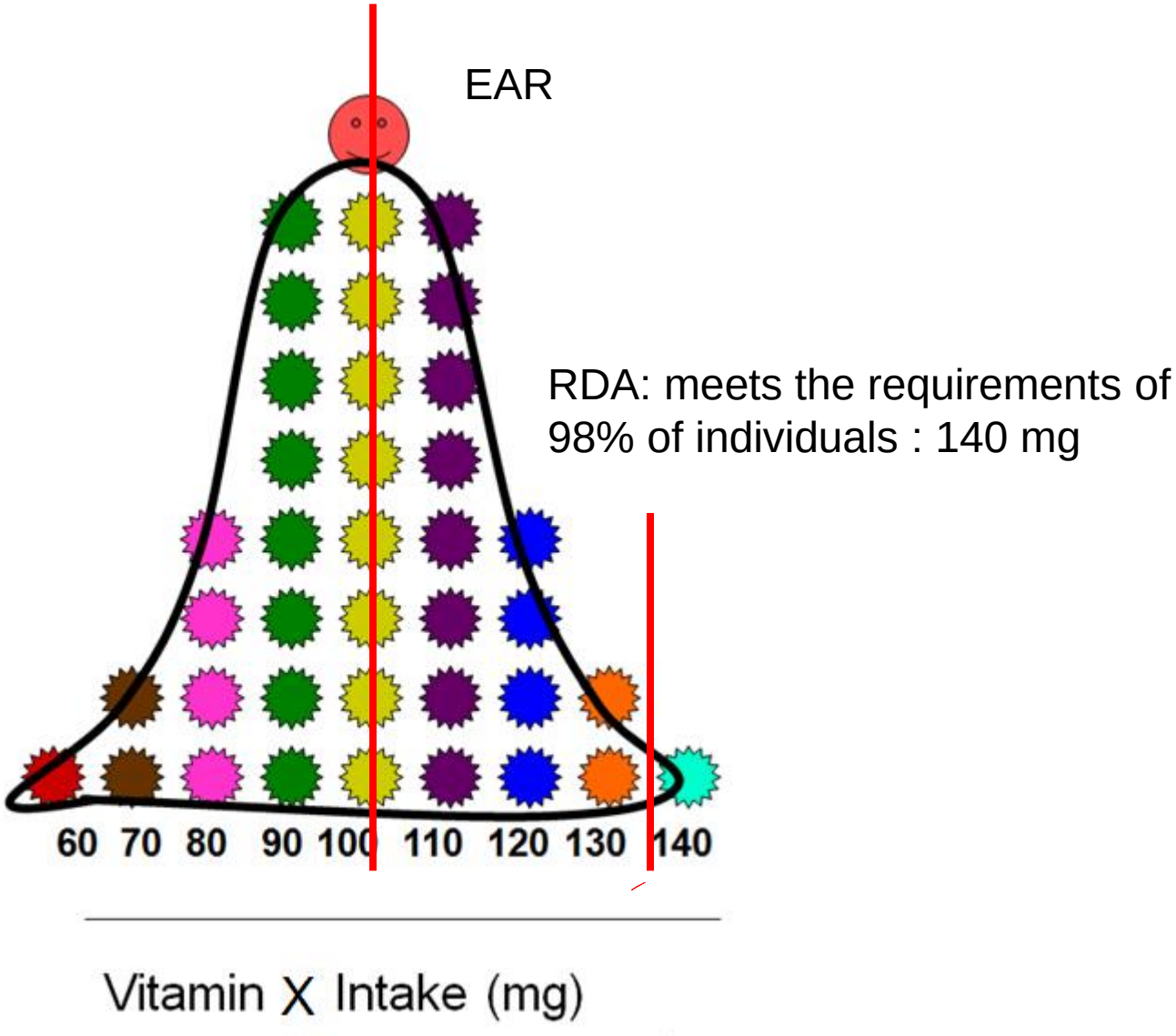


Fig 2.4

2.2 Dietary Reference Intakes
Recommended Dietary Allowance

Fig 2.4



EAR cutpoint methods

- Up to this point, we have looked at **individuals** and the **probability** that they are meeting their **requirements** based on the position intake on the **requirement distribution**

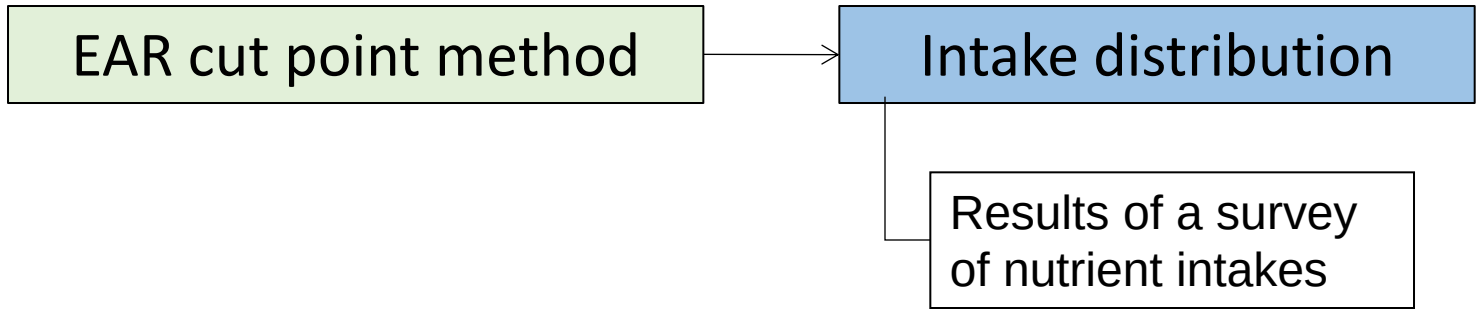
- Now we are going to look at **populations** and the **proportion** of a population meeting its requirements based on an **intake distribution.**

- **This requires a new methodology →**

2.2 Dietary Reference Intakes:

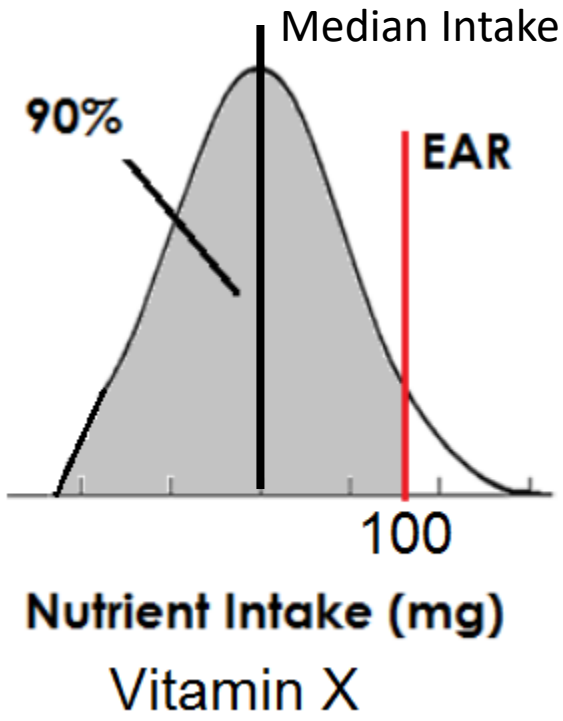
Using the EAR cut point method to determine the Prevalence of Adequate Intake within a Group

- To estimate what proportion of a group is meeting their requirements



2.2 Dietary Reference Intakes: EAR cutpoint method

Intake distribution



EAR cutpoint method

Proportion of the population whose intake is less than the EAR

=

Proportion of the population that is NOT meeting its requirement

Fig 2.6 & 2.7

2.2 Dietary Reference Intakes:
EAR cut point method

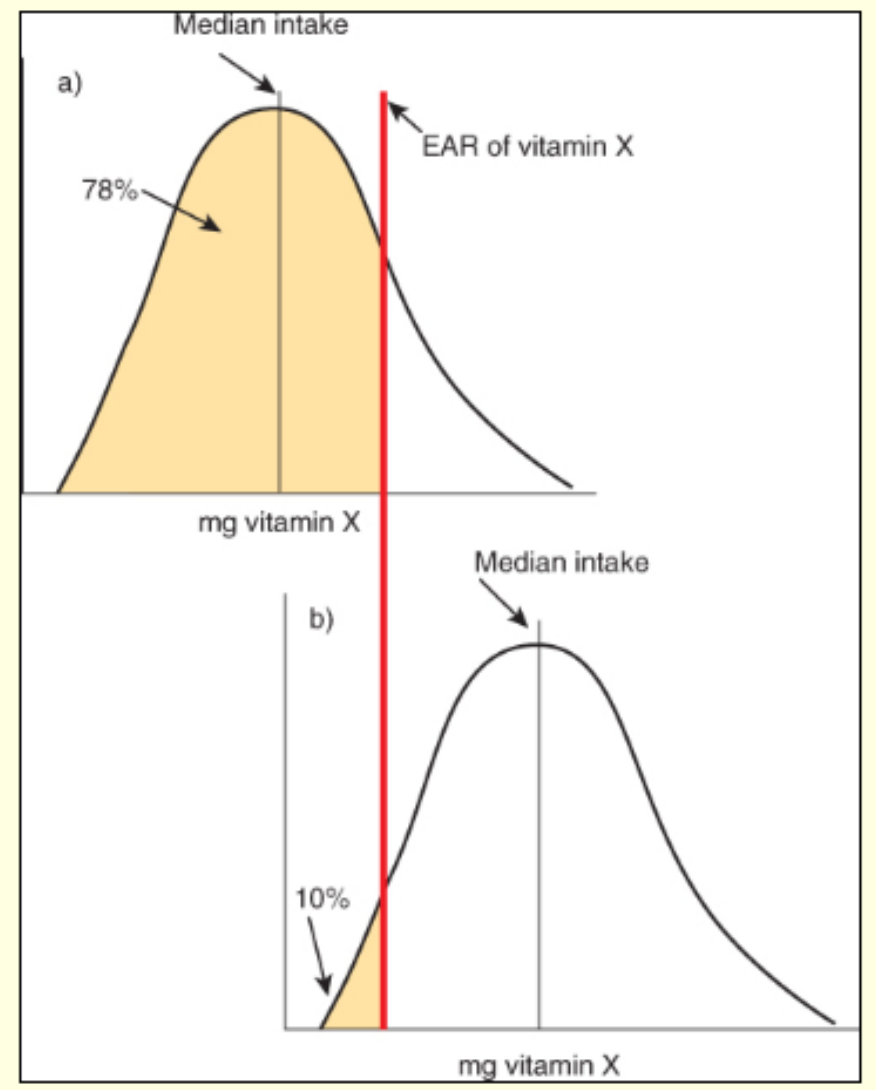
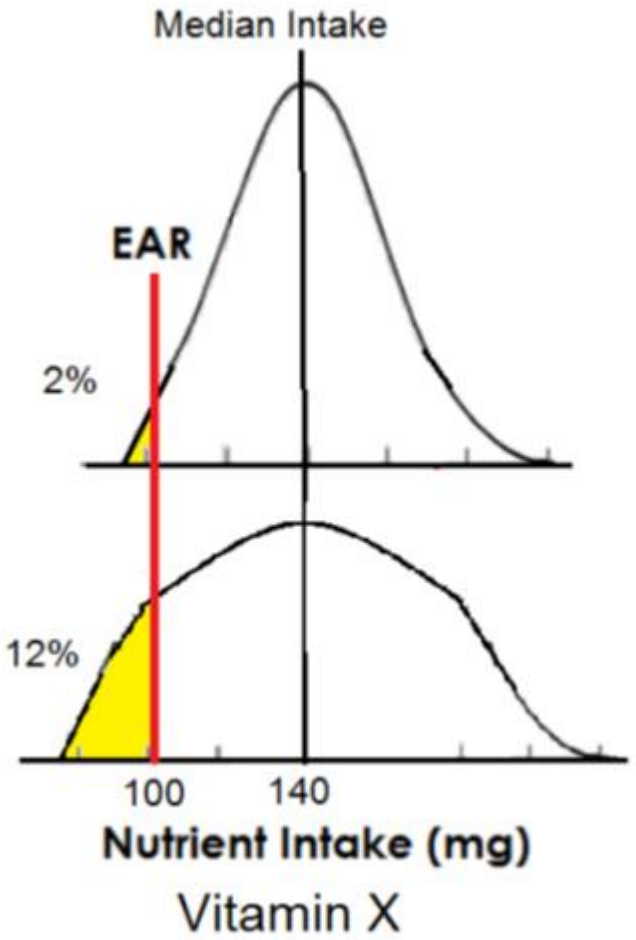


Fig 2.8

QUESTION: If two populations have the same the median intake does that mean that the proportion of the population is meeting its requirement is the same? ANSWER: Not necessarily…

- 

Consider these two **intake distributions**.

How well a population is doing with respect to nutrient intake depends on both the **median intake** and the **standard deviation** of the intake distribution

2.2 Dietary Reference Intakes: How is the EAR cut point method used:

Health Canada:

- Considers a population to have an adequate intake if the proportion of the population whose intake is below the EAR is 10% or less

Remember this range

Canadian Community Health Survey-Nutrition:

- Measured nutrient intake and used the EAR cut point method to determine the adequacy of nutrient intake

2.2 Dietary Reference Intakes:
Adequate Intake (AI)

- Insufficient data to calculate an EAR
  - More research is needed
- Usually based on an estimate of average nutrient intake by a healthy population
- Example: Recommendations for calcium intake for young infants 0-6 months of age = 200mg
  - Adequate intake of 200 mg
    - the average calcium intakes of exclusively breast-fed infants

2.2 Dietary Reference Intakes Adequate Intake

- If your intake > AI, then intake OK
  - AI is good personal target
- If intake <AI your intake may or may not be OK

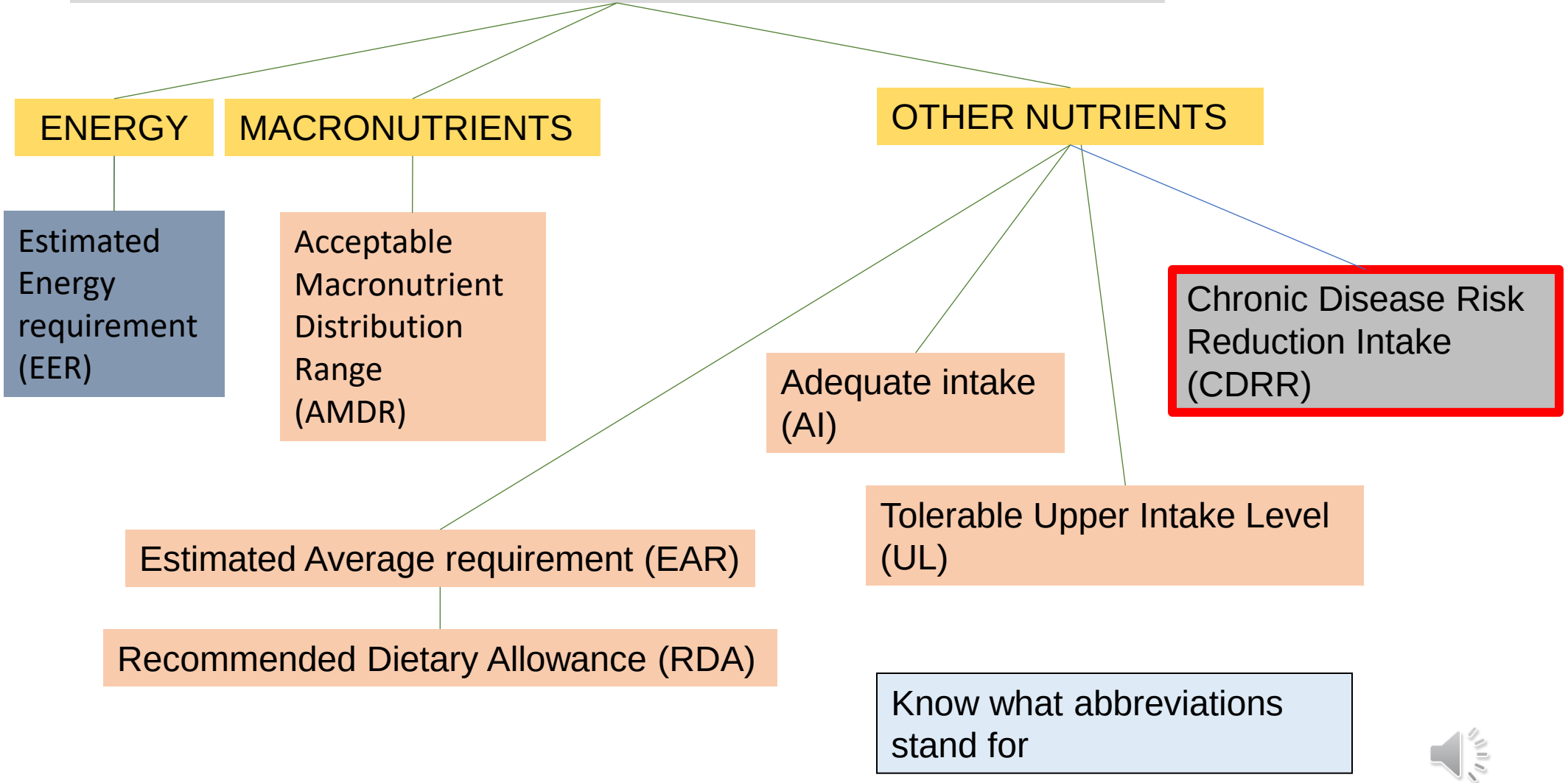
2.2 Dietary Reference Intakes: Tolerable Upper Intake Level (UL)

- The highest level of habitual nutrient intake that is unlikely to pose a risk of adverse effects
  - E.g. if UL = 1 g then you can safely consume 1 g of a nutrient daily without adverse effect
- UL is not a recommended level of intake
  - No additional benefit above RDA
- Because of the popular use of supplements adverse effects are possible
  - Some UL are based only on the amount of nutrient consumed in supplement form

Week 1-Dietary Reference Intakes- Self-Assessment-Section 1

Section 2: DRIs for energy and macronutrients

2.2 DIETARY REFERENCE INTAKES (DRI)



Know what abbreviations stand for

2.2 Dietary Reference Intakes: Energy Balance

Energy content (kcal) of food consumed	=	Energy content expended for metabolism & physical activity	⇨	Weight is unchanged i.e. **Energy balance**
Energy content (kcal) of food consumed	>	Energy content expended for metabolism & physical activity	⇨	Weight gain i.e. **Positive energy balance**
Energy content (kcal) of food consumed	<	Energy content expended for metabolism & physical activity	⇨	Weight loss i.e. **Negative energy balance**

2.2 Dietary Reference Intakes: Estimated energy requirements (EER)

- Equations (determined by experiment) are used to estimate the average energy needs of adults

Men: EER = 662 – (9.53 x age [y]) + PA x (15.91 x weight [kg] + 539 x height [m])

Women: EER = 354 – (6.91 x age [y]) + PA x (9.36 x weight [kg] + 726 x height [m])

See also section 7.3: Estimating Energy Needs pg 274

PA (physical activity term) = 1.00 (sedentary) → 1.48 (very active)

Don't memorize equations, but know the variables involved

2.2 Dietary Reference Intakes: Definitions of activity levels

SEDENTARY:
Activities of daily living; less than 30 min of intentional exercise/day

LOW ACTIVE:
Walking 30 minutes at 6.5 km per hour every day

+ 135 to165 kcal

ACTIVE:
Walking 1 hour 45 minutes at 6.5 km per hour every day

+ 470 to 580 kcal

VERY ACTIVE:
Walking 4 hours 15 minutes at 6.5 km per hour every day

+ 1145 to 1405 kcal

2.2 Dietary Reference Intakes: EER (estimated energy requirement) and age

Female:
5’5”
125 lb
20yrs
Sedentary
BMI 21
1950 kcal

Female:
5’5”
125 lb
50yrs
Sedentary
BMI 21
? kcal

1750 kcal

Female:
5’5”
125 lb
80yrs
Sedentary
BMI 21
? kcal

1550 kcal

2.2 Dietary Reference Intakes EER (estimated energy requirement) and sex

Female:
5’5”
125 lb
20yrs
Sedentary
BMI 21
1950 kcal

Male:
5’5”
125 lb
20yrs
Sedentary
BMI 21
????kcal

2250 kcal

Male:
5’10”
150 lb
20yrs
Sedentary
BMI 21
???? kcal

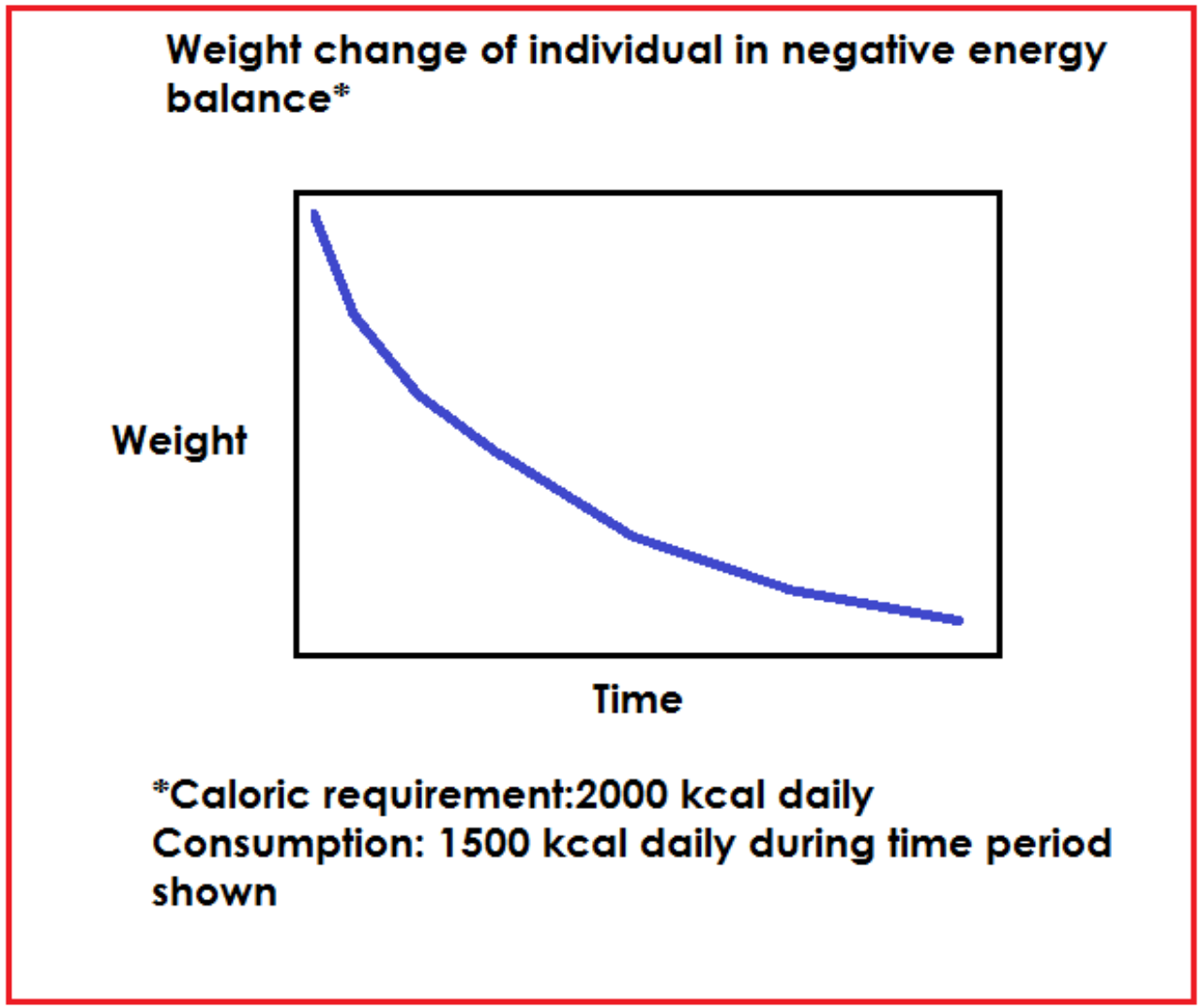
2500 kcal

2.2 Dietary Reference Intakes: EER (estimated energy requirement) and body size

Female:
5’5”
125 lb
20yrs
Sedentary
BMI 21
1950 kcal

Female:
5’5”
150 lb
20yrs
Sedentary
BMI 25
???? kcal

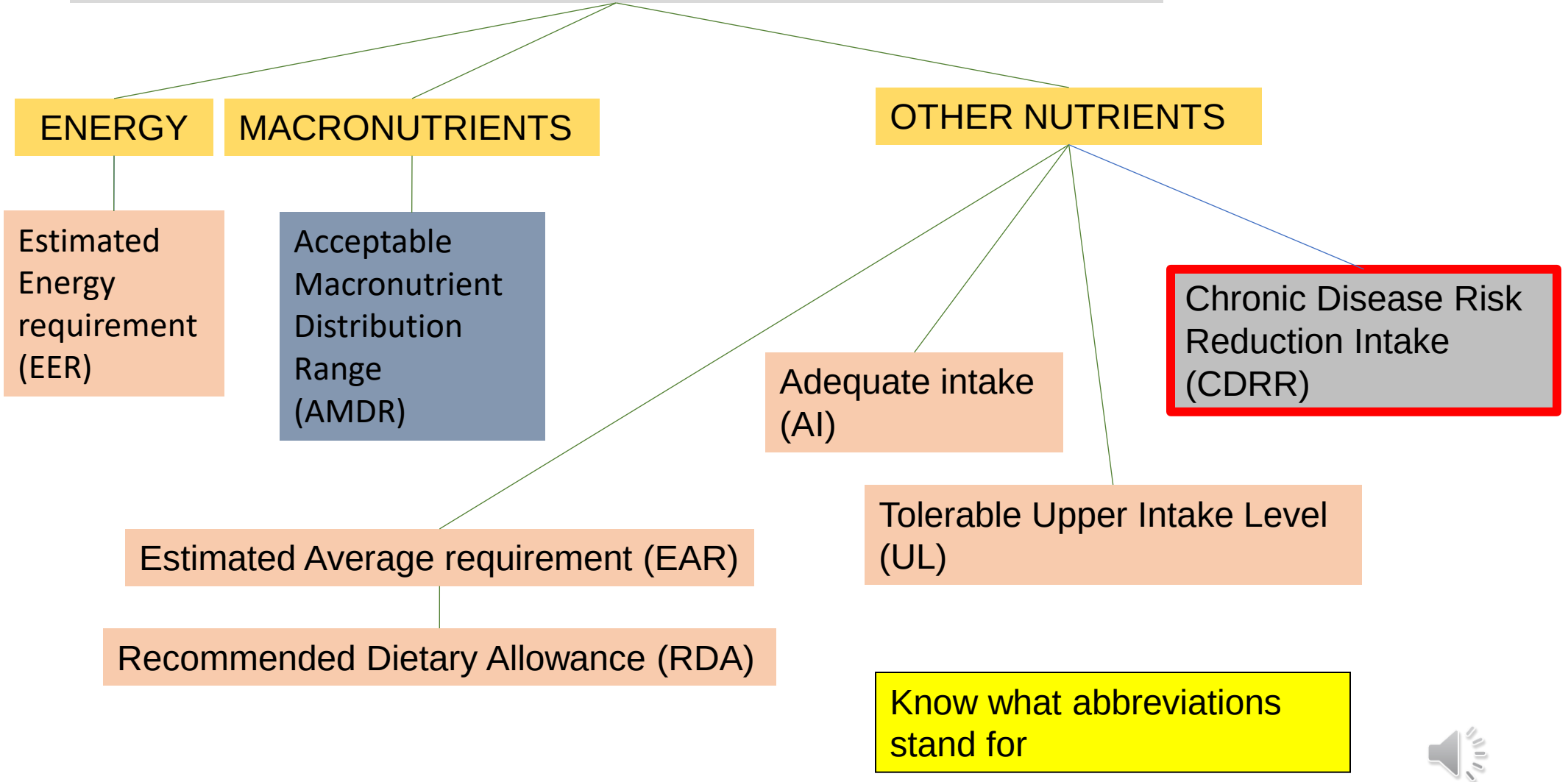
2250 kcal



Energy balance

Consider what happens in positive energy balance.

2.2 DIETARY REFERENCE INTAKES (DRI)



2.2 Dietary Reference Intakes DRIs for macronutrients = AMDR

- Acceptable Macronutrient Distribution Ranges
  - Expressed as % of total kcalories consumed
- Carbohydrates: 45-65%
- Fat: 20-35%
- Protein: 10-35%

Where do these numbers come from?

UNDESIRABLE FATS:

SATURATED FAT:
As low as possible:

<10% kcal (Canada's Food Guide)
<7% kcal (in scientific literature)

TRANS FAT:
<1% kcal- or none at all from partially hydrogenated vegetable oils

2.2 Dietary Reference Intakes:

Question: What percentage of total kcaloric intake for the individual described below comes from each macronutrient?

- An individual consumes a diet that contains:
  - Carbohydrates: 300 gm x 4 kcal/gm = **1200 kcal**
  - Protein: 90 gm x 4= **360 kcal**
  - Fat: 60 gm x 9 kcal/gm = **540 kcal**
  - Total kcalories: 2100 kcal

- Carb: 1200 kcal/2100 = 57%
- Protein: 360 kcal/2100 = 17%
- Fat: 60 gm X 9kcal/g = 540 kcal/2100 kcal = 26%
- Conform to AMDRs?

Consider the following:

- Individual 1:

- Protein intake: 90 g

Total kcalorie intake: 2100 kcal

Protein: 17%

- Individual 2:

- Protein intake: 124 g

Total kcalorie intake:

2900 kcal

- Protein: 17%