What Shall I Eat? => RNI

Recommended Nutrient Intakes

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Lesson: http://Corpet.net/Denis
RNI
Lesson Content

• Recommended Nutrient Intake, Why?

• To Fulfill the Nutritional Needs (Needs = Requirements)
  How can RNI be used, and for whom?
  Nutrients, how much to get enough?

• To Reduce Disease Risk
  - How do we know?
  - Which Diseases could be induced/prevented by diet?
Recommended Nutrient Intakes
RNI, Definition

• Advices given to a population
• To help dietary choices, so that the diet contains enough of all needed nutrients (no deficiency)
• To reduce the risk of chronic diseases (no excess, no imbalance)
• RNI = Recommended Nutrient Intakes
• RDA = Recommended Daily Allowance
• ANC = Apports Nutritionnels Conseillés
• AQR = Apports Quotidiens Recommandés
RNI are important

- To prevent morbidity (diseases) & mortality (no deficiency, no excess, no imbalance)
- To make economical & political choices
  - Agricultural production, importations, taxes, prices, advertising
  - International conferences, country status
    (FAO/WHO => UNO, Third World debt)
Fulfill the Needs (1)

How to use RNI?

- RNI Target population: « normal » people
- Population (not individual): Statistics!
  To meet everyone needs, one must give too much to most people: Is this a waste?
Nutrient Needs

To make it simple:
Standard Deviation SD = 15% thus
RNI = 130% Mean

Mean Need

Number of individuals having "this need"

Minimum Mean -2 SDs

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Fulfill the Needs (2)

What might change people's needs?

- Needs change according to **Body Weight**
  => RNI are given in $g/kg$ (specific RNIs based on kCal)

- Some needs depend on **Gender**
  = e.g., women need more iron, folates, calcium

- Needs depend on **Age**:
  = Kids growth (protein, calcium).
  = Seniors: *which needs are specific?*
Iron needs (Fe)
Women ≠ Men

- 0-8 years: 7 mg/day
- 8-12 year: 8 mg/day
- Teenagers: 12 mg/d boy - 14 mg/d girl
- Adult male: 9 mg/d (9 mg post-menopause)
- Pregnant woman: 25-35 mg/d from 4 to 9 months of pregnancy (need supplements after 1\textsuperscript{er} term)
- Breastfeeding woman: 10 mg/d
Protein RNI g/kg/d
Changes with Age

2.6 g/kg at 1 month
2.1 g/kg at 2 months
1.7 g/kg at 3 months then progressive decrease
1.0 g/kg à 2 years (& pregnant/milking woman)
0.9 g/kg between 2 & 18 years
0.8 g/kg adult. Good quality proteins (minimum 1/3 de animal proteins)
1.0 g/kg seniors (old-timers)

Minimal needs: 0.5 g/kg/day

Kids' needs are well known. Seniors' ones are mostly unknown!
Fulfill the Needs (3)

How to use RNI?

Target « normal » people, and advices for a population (not individual): Statistics!

Needs depend on body weight, on gender, on age

• **Adaptation**: Needs depend on Diet!
  - water, calcium, proteins,…the more you eat, the more you reject

• **Time scale**:
  - Balanced food, balanced meal, balanced week, …?
  - There is no ideal food (*How to advertise?*)
  - Balance is obtained on several days (*How to make menus?*)
How to Know the Needs?
Three Evaluation Methods

• **Empirical** method: To observe what a healthy (or an overtly deficient) population is eating

• **Factorial** method: Balance (intakes vs. outputs)  
  = (expenses, measured experimentally)  
  = (maintenance + activity + growth)  
  E.g., protein needs from N losts

• **Depletion/Repletion** method:  
  Exp. determinat. of minimal intake following a deficient diet

• **Criterion?** Balance (N, K), blood level (Iron, Vitamins),  
  Biomarker (homocystein for folic acid)
  
  • No method is perfect, nor precise, nor universal  
  • RNI are thus temporary and rough (approximated)

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Fulfill Nutrient Needs: Major nutrients

- Water
- Energy /Calories
- Proteins
- Fats
- Carbohydrates
- Minerals
- Vitamins
Fulfill Nutrient Needs:
Eat What, and How Much, to Get Enough?

• Water: control = thirst (good example of balance problem)
## Water: input-output

<table>
<thead>
<tr>
<th>Input</th>
<th>2,300 ml</th>
<th>Output</th>
<th>2,300 ml</th>
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<tbody>
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<td>Drinks</td>
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<td>Urine</td>
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<td>Metabolic w</td>
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<td>Fecal water</td>
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<td>Food water</td>
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<td>Sweat</td>
<td>300</td>
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</table>
Fulfill Nutrient Needs:  
Eat What, and How Much, to Get Enough?

- **Water**: control = thirst (good example of balance problem)
- **Energy /Calories**: control = hunger  
  Best control: Body weight, BMI stability.

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Recommended **Energy** Intakes

Sources: fat 9, carb. 4, prot. 4 kCal/g

Median need: **2 400 kCal/d** (=how many grams of carbohydrate?)

**1800 kCal/d** sedentary woman

**3400 kCal/d** very active man

Many different systems to determine energy intake: f(age, weight, physical activity…) equations, tables, software

Primary control: **appetite/satiety** (often overcome)

Secondary control: **stable body weight**

Optimal **Body Mass Index**, \(= \text{BW}/\text{H}^2\)  **BMI [19-25]** kg/m\(^2\)

More expenses, High Nutr. Density >> Reduced Calories
Body Mass Index & Death, Women and Men (USA)

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E. Calle, NEJM. 1999
Diapo.: Françoise Clavel
More Obesity in the Poor

France, Obepi survey (MA Charles, Obesity 2008)

In France, hope
France, a frightening epidemic, but there is hope

- Adults obesity raise slows down in 2012
- Kids obesity raise stopped in 2000

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Developing Countries: Low-Weight and Obesity!

Double-Burden: Pre-school kids are too small and too fat

OMS 2000 and Kelly 2008

BMI<17
- Insuffisance pondérale (IMC<17)
- Obésité (IMC >30)
BMI>30

Rich / Poor / COUNTRIES
Fulfill Nutrient Needs:
Eat What, and How Much, to Get Enough?

- **Water**: control = thirst (good example of balance problem)
- **Energy /Calories**: control = hunger
  Best control: Body weight, BMI stability.
- **Proteins**: total nitrogen/ Essential Amino Acids
  Biological Value/ complementation
  Where is the control? Is there a specific appetite?
Protein Needs

- Total Protein: 0.6 to 1 g/kg BW/day
- Essential Amino Acids: N=8
  Leucine, Isoleucine, Phenylalanine, Threonine, Tryptophan, Valine, Methionine, Lysine
- Biological Value =
  AA balance (no limiting AA) & protein digestibility (fecal Nitrogen)
- AA complementation:
  - Wheat:  high SC (Met+Cys),  low Lys
  - Beans:  low SC (Met+Cys),  high Lys
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- **Fats**: Essential Fatty Acids = n-3 & n-6 PUFA
Fat Needs: Lipids

• *Fat bears Calories and fat-soluble Vitamins: A, D, E*

• Three classes of **Fatty Acids**: Saturated FA/ Mono-Unsat. MUFA / Poly-Unsat. PUFA

• RNI 30-35% calories - Sfa/Mufa/Pufa: **10/10/10** 10/10/10 or the Mediterranean olive oil model : **10/20/10**

• **Essential Fatty Acids**: two classes, no conversion
  
  **n-6 PUFA** = Omega 6, linoleic acid C18:2 n-6: **4% Cal**
  
  **n-3 PUFA** = Omega 3, α-linolenic acid C18:3 n-3: **1% Cal**
  
  + long chain n-3 PUFA (fish oil) EPA+DHA: **500mg/d**

• **n-3/n-6 Ratio usually**: 1/20-1/10, but shoud be 1/4
Fat: Glycerol + 3 Fatty Acids

ω3 oil: canola (rapeseed, colza), soy, fish oils
ω6 oil: corn (maize), sunflower, meat fat.
## RNI for fat

Pourcent energy, except EPA & DHA : mg

<table>
<thead>
<tr>
<th>Lipides totaux</th>
<th>Acide linoléique C18 : 2 n-6</th>
<th>Acide α-linolénique C18 : 3 n-3</th>
<th>Acide docosahexaénoïque DHA, C22 : 6 n-3</th>
<th>Acide eicosapentaénoïque EPA, C20 : 5 n-3</th>
<th>Acide laurique (C12:0) + Acide myristique (C14:0) + Acide palmitique (C16:0)</th>
<th>Acides Gras Saturés totaux</th>
<th>Acide oléique C18 : 1 n-9</th>
<th>Autres AG non indispensables</th>
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<tr>
<td>30</td>
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<td>≥ 200-300 mg</td>
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<td>250 mg</td>
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</table>

Reco-Nutr: RNI - 2013
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  Where is the control? Is there a specific appetite?
- **Fats**: Essential Fatty Acids = n-3 & n-6 PUFA
- **Carbohydrates**: 150g/d glucose brain & 30g fiber
- **Minerals**: Ca (P) (Na) K Mg Fe …
- **Vitamins**: water soluble (B1-9, C, K, PP), fat soluble (A, D, E)
Carbohydrates

• Little needs 150g/d (brain needs glucose, but liver can make it from proteins, gluconeogenesis)

• Since fat RNI =30% calories, and protein = 15% cal, by difference, Carbohydrate should make 55% cal. (45 to 60% of calories), Fibers 25g to 30 g/d

• «Slow» carb. is better, but all starches are not slow

• **Glycemic Index** = blood glucose peak (2h post-meal) Peak Ratio (50g carb.food vs. 50g pure glucose)

  • Low Glycemic Index is Better! 
  *No insulin resistance, less diabetes, less obesity*…
Glycemic Index

- High GI 80-100: Glucose, white bread, rice, potatoes, corn flakes
- Medium GI 50-80: Noodles, spaghetti, pumpernickel bread, sugar (sucrose)
- Low GI < 50: Beans, lentils, peas, apple, orange, peanuts

Glycemic response in healthy adults

Plasma glucose response (mmol/L) from a high vs low GI food. The change in blood glucose concentration over time is expressed and calculated as the area under the curve (AUC) (Wolever et al, 1991).
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Vitamins & Minerals
"Risky" Nutrients (deficiencies)

- **Use RNI tables** (e.g., Canada)
- **Calcium** 1 g/d (more for kids and teenagers),
- **Iron (Fe)** 9 mg/d (twice more for women)
- **Vitamin A** (poor countries: *xeropthalmia blindness*)
- **Iodine** (when far from sea: *mental retardation*)
- **Vit. D** (little sun, dark skin: *rickets, bone disease*)
- **Vit. B9** = folates folic acid (pregnant: *spina bifida*)
- **Vit. B12** (vegan, seniors: *anemia*)
### Example of RNI table

**Recommended Nutrient Intakes (Philippines 2002)**

<table>
<thead>
<tr>
<th>Population group</th>
<th>Weight kg</th>
<th>Magnesium mg</th>
<th>Phosphorus mg</th>
<th>Zinc mg</th>
<th>Selenium mg</th>
<th>Fluoride mg</th>
<th>Manganese mg</th>
<th>Vitamin D µg</th>
<th>Vitamin E mg</th>
<th>Vitamin K mg</th>
<th>Vitamin B12 µg</th>
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<td>2.5</td>
<td>2.0</td>
<td>5</td>
<td>12</td>
<td>51</td>
<td>1.9</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Lactating women</strong></td>
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<tr>
<td>1st Emos.</td>
<td>250</td>
<td>700</td>
<td>11.5</td>
<td>40</td>
<td>2.5</td>
<td>2.6</td>
<td>5</td>
<td>16</td>
<td>51</td>
<td>2.0</td>
<td>2.8</td>
</tr>
<tr>
<td>2nd 6 mos.</td>
<td>250</td>
<td>700</td>
<td>11.5</td>
<td>40</td>
<td>2.5</td>
<td>2.6</td>
<td>5</td>
<td>16</td>
<td>51</td>
<td>2.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Nutrition Labelling

Clocks are easy to understand

Une portion de 80 g vous apporte pour la journée 24h

Kcal 5%
Energie

Proteines 8%
Eiwitten

Sucres Simples 1%
Eenvoudige Suikers

6%
Sucres Complexes Meervoudige

3%
Matières Grasses Vetten

23%
Fibres Vezels

* Calcul réalisé pour une personne dont les Apports Journaliers Recommandés sont de 2000 kcal /
* Berekening voor een persoon voor wie de Aanbevolen Voedingshoeveelheden 2000 kcal bedragen.

2400 kcal. 1900 kcal.
How can those complex recommendations be simply communicated to people?

• Food Groups (colors): milk, meat, fruits & veg., starchy foods, fat
  Plus advices on the number of daily portions

• Pyramid (USA): it often changes!

• Many other systems: the simpler the better!
Food Groups - colors

Blue Group
2-3 per day

Red Group
1-2 per day

Green Group
4-5 per day

Brown Group
Each meal
BIEN MANGER, BOUGER, PROTÈGE VOTRE SANTÉ.

1 ou 2 fois par jour
Viandes, œufs et poissons

3 par jour
Produits laitiers

5 par jour au moins
Fruits & légumes

Bouger au moins 30 minutes par jour!

A chaque repas selon l’appétit
Féculents
Sucré
Gras
Salé

limiter la consommation

Pour plus d’informations
www.mangerbouger.fr

Denis E. Corpet
Reco-Nutr: RNI - 2013
Pyramid => mediterranean
China 1997-2007

Fats and Oils, 25g
Milk and Milk Products, 100g
Bean and Bean Products, 50g
Meat and Poultry, 50-100g
Fish and Shrimp, 50g
Eggs, 25-50g
Vegetables, 400-500g
Fruits, 100-200g
Cereals, 300-500g

China Nutrition Society
Anatomy of MyPyramid

One size doesn't fit all
USDA's new MyPyramid symbolizes a personalized approach to healthy eating and physical activity. The symbol has been designed to be simple. It has been developed to remind consumers to make healthy food choices and to be active every day. The different parts of the symbol are described below:

Activity
Activity is represented by the steps and the person climbing them, as a reminder of the importance of daily physical activity.

Moderation
Moderation is represented by the narrowing of each food group from bottom to top. The wider base stands for foods with little or no solid fats or added sugars. These should be selected more often. The narrower top area stands for foods containing more added sugars and solid fats. The more active you are, the more of these foods can fit into your diet.

Personalization
Personalization is shown by the person on the steps, the slogan, and the URL. Find the kinds and amounts of food to eat each day at MyPyramid.gov.

Proportionality
Proportionality is shown by the different widths of the food group bands. The widths suggest how much food a person should choose from each group. The widths are just a general guide, not exact proportions. Check the Web site for how much is right for you.

Variety
Variety is symbolized by the 6 color bands representing the 5 food groups of the Pyramid and oils. This illustrates that foods from all groups are needed each day for good health.

Gradual Improvement
Gradual improvement is encouraged by the slogan. It suggests that individuals can benefit from taking small steps to improve their diet and lifestyle each day.
It is Smarter
Knowing your Target

• Instead giving precise advices on all nutrients
• Concentrate message on useful changes, on "bad" behaviors
• Message should not be the same in each country, not the same for everybody
• E.g., French PNNS
Intake of Major Foods in France 1950-2000

- Céréales, pommes de terre
- Fruits, légumes
- Lait, produits laitiers
- Viande

Source: INSEE Annuaire
French PNNS, Programme National Nutrition Santé

1. Increase fruits & vegetables
2. Increase calcium intake
3. Reduce fat intake
4. Increase carbohydrates
5. Reduce alcohol intake
6. Reduce blood cholesterol
7. Reduce blood pressure
8. Reduce obesity
9. Increase physical activity
SAIN,LIM Nutrient Profiling System

  EFSA food profile for health claims EC regulation no 1924/2006

- SAIN is "good": a high SAIN score is wanted since it means lots of good nutrients vs. Calories

- LIM is "bad": a low LIM score is wanted since it means less "bad" nutrients (already too much)
**SAIN, LIM**

**Nutrient Profiling System**

**SAIN score** (calculated for 100 kCal of food)

How can each food provide five basic positive nutrients?

- Protein: 65g
- Fiber: 25g
- Vitamin C: 110mg
- Calcium: 900mg
- Iron: 12.5 mg

\[
SAIN_i = \sum_{p=1}^{p=5} \text{ratio}_{ip} \times 100
\]

where

\[
\text{ratio}_{ip} = \left[ \frac{\text{nutrient}_{ip}}{RV_p} \right] \times \frac{100}{E_i}
\]

**nutrient** \(ip\) is the quantity (g, mg, or µg) of positive nutrient \(p\) in 100 g of food \(i\), \(RVp\) is the daily recommended value for nutrient \(p\), and \(Ei\) is the energy content of 100 g of food \(i\) (in kcal/100 g).
SAIN,LIM
Nutrient Profiling System

**LIM score**: (calculated for 100 g of food)

How can each food provide excess of negative nutrients?

- Saturated Fatty Acids 22g
- Added Sugars 50g
- Sodium 3g (= 8g salt)

\[
\text{LIM}_i = \frac{1}{3} \sum_{l=1}^{3} \text{ratio}_{il}
\]

\[
\text{ratio}_{il} = \left[ \frac{\text{nutrient}_{il}}{\text{MRV}_l} \right] \times 100
\]

where nutrient \( il \) is the content (g, mg) of limited nutrient \( l \) in 100g of food \( i \), and \( \text{MRV}_l \) is the daily maximal recommended value for nutrient \( l \).
English, but hard to read: sorry!
Next slide is better... but French
Finally to conclude, What is a Good Diet?

- **Eat not too much & Move**: Keep BMI [19-25]
- **Balance**: Carbohydrates - Fat - Proteins
  - % Calories: approx. Fat 30%, Prot. 15%, Carb. 55%
  - Choose good Quality carbohydrate, fat, protein
    - Low Glycemic Index starch, more Fiber (30 g/d)
    - Fats SFA<1/3, PUFA: n-3/n-6 ratio ¼, DHA+EPA 0.5g/d
  - Diversify foods (micronutrients, phytochemicals)
  - Increase fruits & vegetables (400-800g/d)
mangez
sain et sympa!
Bon appétit!

Conference is online
http://Corpet.net/Denis/