Designing Healthy Diets

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Energy and nutrient content per serving by student ID (Lab 2)

Energy (kcal/serving)

Iron (mg/serving)

Protein (g/serving)

Vitamin C (mg/serving)

# 11 is the gold standard/correct answer
Challenges for designing healthy diets in low resource settings

- Are there Dietary Reference Intakes (DRI) or nutrient requirements on which to judge adequacy?
- Are there dietary goals in the form of Dietary Guidelines for chronic disease prevention?
- Do we have information on what people eat?
- Do we have information on the nutrient composition of foods?
- Do we have information on preparation, cooking and retention factors?
- Do we have information on food storage/preservation/refrigeration? Market availability? On prices?
- What do we know about cultural factors, lifestyle, societal norms about food, eating, etc?
DRI, RNI, DRV, and NIV: What are they?

• Overall concept: absolute intakes to meet requirements
  – DRI, Dietary Reference Intake US and Canada
  – RNI, Recommended Nutrition Intake, FAO/WHO for global use (like RDA for nutrients)
  – DRV, Dietary Reference Value, UK
  – NIV, Nutrient Intake Value, 2005 language from an attempt to harmonize

• Most use the RNI from FAO/WHO to evaluate the adequacy of diets in low-resource settings, but may use US DRI when necessary
  – Many of the values are similar because they are based on biologic requirements and modified by variables (best example: bioavailability)
  – When you read articles on dietary adequacy, you should identify the source of the requirements used, and you should read the reference to understand how the value was derived

• There is a global movement to harmonize the science and process to derive global nutrient requirements – what will they be called?
  – Estimated average requirement, intake at which most peoples needs are met, upper limit to safety, a reasonable amount associated with health

- A healthy diet emphasizes: fruit, vegetables, legumes (e.g. lentils and beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat and brown rice).

- At least 400 g (i.e. five portions) of fruit and vegetables per day (excluding potatoes, sweet potatoes, cassava and other starchy roots).

- Total fat should not exceed 30% of total energy intake
  - Intake of saturated fats should be less than 10% of total energy intake
  - Trans fats < 1% of total energy intake, particularly industrially produced trans fats

- Limit free sugars to less than 10% of total energy intake (12 teaspoons in a 2000 kcal diet)
  - Free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.
  - less than 5% of total energy intake would be more beneficial

- Keep salt intake to less than 5 g per day (equivalent to sodium intake of less than 2 g per day). Salt should be iodized.

NOTE: on what are they silent?
Information on Dietary Intakes

• national surveys
  – NHANES
  – National nutrition surveys in other countries may or may not be comprehensive

• DHS surveys provide limited and qualitative information on yesterday’s diet (did you eat a grain? Did you eat a meat?, etc.,)

• Research studies involving 24 hr recalls provide best information on energy and nutrient intakes in select populations if there are no national surveys

• INDDEX project
International Dietary Data Expansion (INDDEX) Project

Gates funded initiative led by Tufts University with FAO and IFPRI

Goals

1. Development of technologies to standardize and streamline the collection and analysis of individual-level dietary data
2. Improve the design and use of the food data collected in household consumption and expenditure surveys
3. Demonstrate how to appropriately use “fit for purpose” indicators and analyses from dietary intake data HCES and food balance data
4. Develop guidance that will effectively communicate these scientific advancements and technological advancements to stakeholders
Food Composition Tables (FCT)

- Energy, macro- and micronutrients in 100 g food/beverage
- USDA, most widely used food composition database
- INFOODS FAO initiative to increase the quality of information on food composition worldwide
  - Center leadership in each region for chemical analyses, make progress
  - Common procedures, metrics
  - Excellent resource for dietary assessment around the globe
Best practices for assembling food composition data

• Choose a base FCT with the nutrients you need
  – Understand how it was made

• Identify additional FCT as resources
  – Consider global relationships
    • Imported food, where does it come from?
    • Where do emigrants live?
      – UK, Australia for South Asian product information
    – Research literature (food science journals), particularly for local plants
    – Wikipedia to get information on botanical and geographic distribution, other names information
      • What is it like?
Preparations?

• Collect recipes – how many?
  – collect 5-6 versions and create one average recipe and stop
  – Ask locals (KII) to get an average recipe
  – Collect more recipes, create a base recipe and variants (rice +....)
  – Collect everyone’s recipe!

• What if you don’t have a recipe?
  – Cookbooks (create average, common recipe)
  – Internet (websites, Youtube videos)
  – Recipe substitute for a commercial product
Developing Health Diets: Tools for improving nutrient adequacy of diets

- ProPAN (Process for the promotion of child feeding)
  - 4 modules (assessment, testing recommendations and recipes, developing intervention, designing M&E)
- Optifood - linear programming tool to identify food-based recommendations for achieving nutrient adequacy
- CotD – “Cost of the diet” linear programming tool that builds on Optifood and identifies lowest cost diet
- Fill the Nutrient Gap (FNG) framework for thinking through HOW to fill the gap between current diet and an adequate diet, focuses on policies and programs
- MoRES – Monitoring Results for Equity System is a 7 step approach to change, using system approach through an equity lens
Optifood (4.0.9.0)

- Linear programming utilizes data (food items, food groups, amounts consumed, frequency of consumption, nutrient composition/gram, energy and nutrient requirements, [cost (maybe)]) to identify optimal solution
- The optimal solution is a set of food recommendations for 7 days [usually] which will achieve nutrient adequacy for each of 11 nutrients (plus energy and protein)
  
  Steps:
  - Identify problem nutrients (throughout much of the world (Fe, Zn and Ca))
  - Identify best available food sources to fill nutrient gaps
  - Alternative recommendations to improve adequacy

- NOTE: the concept has been expanded to consider environment and sustainability (Van Dooreen paper)
Where should the intake distribution be?

In the top slide, if median intakes are equivalent to RDA, then $\Pr(\text{inadequacy}) = 28\%$ (those with intakes $< \text{EAR}$).

Recommended by NAS (DRI) and FAO/WHO:
Median intake high enough such that about 2.5% of population have $\Pr(\text{inadequacy}) > 0$ (2.5% is $< -2\text{SD intake distribution}$).
Problem nutrients Kenyan children 6-24 months of age (Vossenaar et al 2016)

- Calcium, Thiamin, Niacin, Vitamin B6, Folate, Iron, Zinc
- Nutrients for which local foods could meet the requirement but doing so would create problems for other micronutrients:
  - Calcium, Thiamin, Niacin, B6, Folate
- Nutrients for which local foods could NOT meet the requirement
  - Iron
  - Zinc (except for some older children)
**Best sources of each of 11 nutrients among settled communities in northern Kenya (contributes 5% of intake)**

<table>
<thead>
<tr>
<th>Food subgroup</th>
<th>Example</th>
<th>6-8 months</th>
<th>9-11 months</th>
<th>12-23 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast milk</td>
<td>Breast milk</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fluid/powdered milk</td>
<td>Fresh goat’s milk</td>
<td>8</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Starchy plant</td>
<td>Potato</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Beans/lentils/peas</td>
<td>Red kidney beans</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Unenriched whole grain</td>
<td>Millet flour</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Red meat</td>
<td>Goat meat</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Enriched whole grain</td>
<td>Fortified maize flour</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>DGLV</td>
<td>Kale</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vitamin C veg.</td>
<td>Tomato</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vit A vegetable</td>
<td>Butternut squash</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vit A fortified margarine</td>
<td>Vit A fortified margarine</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Eggs</td>
<td>Eggs</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Complementary Feeding Recommendations for children 6-24 months in settled communities and in Northern Kenya

- Breastfeed on demand

<table>
<thead>
<tr>
<th>Age group</th>
<th>Animal milks</th>
<th>Potato or green banana</th>
<th>Grain or grain products</th>
<th>Beans</th>
<th>Vit A fortified fat/oil</th>
<th>Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-8</td>
<td>14 (40)</td>
<td>7 (30)</td>
<td>-</td>
<td>7 (30)</td>
<td>7 (5)</td>
<td>-</td>
</tr>
<tr>
<td>9-11</td>
<td>14 (65)</td>
<td>14 (50)</td>
<td>7 (20)</td>
<td>7 (30)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12-23</td>
<td>21 (65)</td>
<td>14 (50)</td>
<td>7 (20)</td>
<td>7 (30)</td>
<td>-</td>
<td>7 (90)</td>
</tr>
</tbody>
</table>

Beans: pinto, kidney, mung, or cranberry
Fruit: banana, orange, papaya, or passion fruit

No meat? No fruit until 12 months? No DLGV?
Food based dietary guidelines for 3-6 year old Malawian children from LP

**Food plenty season**
- A daily portion of > 204 g of maize flour
- A daily portion of > 19 g fish relish, which must be small dry fish
- A daily amount of leaf relish > 69 g twice every 3 days
- At least 2 snacks every day, at least once per 3 days, it should include > 179 g of pumpkin

**Food shortage season**
- A daily portion of > 229 g of maize flour
- A daily portion of > 19 g fish relish which must be small dry fish
- A daily amount of leaf relish > 69 g once every 3 days
- A daily portion of legume relish > 29 g of dry beans once every 3 days
- At least 3 snacks per day, which should include > 119 g mango every day
Summary

• There are multiple challenges to designing healthy diets for low resource settings, for individuals with constrained food choices
  – Limited information on usual diet, foods consumed, recipes and sometimes nutrient composition of the foods
  – Limited tools for data collection (area of expansion)
• DIY approaches are used because of limits for tools like NDSR
• Linear programming is a data-driven approach to identify the minimal solution as the basis for making food-based dietary guidelines to meet energy and nutrient adequacy