Food Supply vs. Healthy Diet

Recommendations:
What are the gaps?

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Outline of presentation

• What is the future goal for the food supply “basket” of low- to middle-income countries?
• How large is the gap between current country-level food supply and the future goal?
  – Test case: Cameroon
• Dietary Gap Assessment approach
• Results for Cameroon
• Limitations of this approach
• Conclusions and implications
Goal: Diets that both reduce nutrient deficiencies and help prevent chronic disease

- Consumption of nutrient-rich foods including fruits, vegetables, nuts, beans and animal-source foods, is linked to nutrient adequacy.
- “Healthy” dietary patterns designed for prevention of overweight and chronic diseases also emphasize these food groups.
  - E.g., adequate intake of fruits and vegetables associated with reduced incidence of:
    - Certain cancers (Boeing, 2012)
    - Hypertension and cardiovascular disease (Hartley, 2013)
    - Weight gain and type II diabetes (Cooper, 2012)
## Development transitions

[from Nugent et al. Bringing Agriculture to the Table, 2011]

<table>
<thead>
<tr>
<th></th>
<th>Pre-transition, Low Income:</th>
<th>Transitional, Low Income:</th>
<th>Transitional, Middle Income:</th>
<th>Completed Transition, High Income: United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>Burkina Faso</td>
<td>Bangladesh</td>
<td>Brazil</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>NCD burden of disease</td>
<td>20%</td>
<td>41%</td>
<td>64%</td>
<td>89%</td>
</tr>
<tr>
<td>Overweight &amp; obese</td>
<td>13%</td>
<td>8%</td>
<td>53%</td>
<td>62%</td>
</tr>
<tr>
<td>Child stunting (5-year-olds)</td>
<td>45%</td>
<td>43%</td>
<td>7%</td>
<td>0%</td>
</tr>
</tbody>
</table>
What is a “Healthy Diet”? 

• National- and regional-level dietary guidelines: 
  – Promote eating habits associated with achievement of country-specific nutrition and health goals; reflect specific food cultures 
  – Recommend consuming minimum and (sometimes) maximum quantities of foods or food groups associated with health outcomes 
  – May or may not be evidence-based 

• WHO recommendation (2014): 
  “As part of a healthy diet low in fat, sugars and sodium, WHO suggests consuming more than 400 grams of fruits and vegetables per day to improve overall health and reduce the risk of certain NCDs”
Evidence-Based Dietary Guidelines

Example: the DASH dietary pattern

• “Dietary Approaches to Stop Hypertension” (DASH) developed in the 1990s

• Rigorous evaluation demonstrated significant reductions in blood pressure, particularly among study participants with hypertension (Harsha, 1999)

• DASH emphasizes low sodium intake, increased consumption of fruits & vegetables, whole-grain cereals, and balanced intake of lean meats, poultry, fish, eggs and low-fat dairy products
Fruit & Vegetable Consumption Recommendations (per 2100 kcal/day)

- DASH: ~720 grams/day
  (depends on types of F/V consumed)
- ~5 servings/day (~600 grams/day for adults)
  [Siegel KR et al. PLOS One 2014]
- WHO (2014): >400 grams/day
- United States Department of Agriculture Food Patterns: 4.5 cups/day
  (recommendation provided by volume, not weight)
# Following the DASH Eating Plan

Use this chart to help you plan your menus—or take it with you when you go to the store.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Servings Per Day</th>
<th>Serving Sizes</th>
<th>Examples and Notes</th>
<th>Significance of Each Food Group to the DASH Eating Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains*</td>
<td>6</td>
<td>1 slice bread</td>
<td>Whole wheat bread and rolls, whole wheat pasta,</td>
<td>Major sources of energy and fiber</td>
</tr>
<tr>
<td></td>
<td>6-8</td>
<td>1 oz dry cereal</td>
<td>English muffin, pita bread, bagel, cereals, grits,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-11</td>
<td>1/2 cup cooked rice, pasta, or cereal</td>
<td>oatmeal, brown rice, unsalted pretzels and popcorn</td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>3-4</td>
<td>1 cup raw leafy vegetable</td>
<td>Broccoli, carrots, collards, green beans, green</td>
<td>Rich sources of potassium, magnesium, and fiber</td>
</tr>
<tr>
<td></td>
<td>4-5</td>
<td>1/2 cup cut-up raw or cooked vegetable</td>
<td>peas, kale, lima beans, potatoes, spinach, squash,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-6</td>
<td>1/2 cup vegetable juice</td>
<td>sweet potatoes, tomatoes</td>
<td></td>
</tr>
<tr>
<td>Fruits</td>
<td>4</td>
<td>1 medium fruit</td>
<td>Apples, apricots, bananas, dates, grapes, oranges,</td>
<td>Important sources of potassium, magnesium, and fiber</td>
</tr>
<tr>
<td></td>
<td>4-5</td>
<td>1/4 cup dried fruit</td>
<td>grapefruit, grapefruit juice, mangoes, melons,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-6</td>
<td>1/2 cup fresh, frozen, or canned fruit</td>
<td>peaches, pineapple, raisins, strawberries, tangerines</td>
<td></td>
</tr>
<tr>
<td>Fat-free or low-fat milk and milk products</td>
<td>2-3</td>
<td>1 cup milk or yogurt</td>
<td>Fat-free (skim) or low-fat (1%) milk or buttermilk,</td>
<td>Major sources of calcium and protein</td>
</tr>
<tr>
<td></td>
<td>2-3</td>
<td>1/2 oz cheese</td>
<td>fat-free, low-fat, or reduced-fat cheese; fat-free,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>low-fat regular or frozen yogurt</td>
<td></td>
</tr>
<tr>
<td>Lean meats, poultry, and fish</td>
<td>3-6</td>
<td>1 oz cooked meats, poultry, or fish</td>
<td>Select only lean; trim away visible fat; broil,</td>
<td>Rich sources of protein and magnesium</td>
</tr>
<tr>
<td></td>
<td>6 or less</td>
<td>1 egg</td>
<td>roast, or poach; remove skin from poultry</td>
<td></td>
</tr>
<tr>
<td>Nuts, seeds, and legumes</td>
<td>3 per week</td>
<td>1/2 cup or 1 1/2 oz nuts</td>
<td>Almonds, hazelnuts, mixed nuts, peanuts, walnuts,</td>
<td>Rich sources of energy, magnesium, protein, and fiber</td>
</tr>
<tr>
<td></td>
<td>4-5 per week</td>
<td>2 Tbsp peanut butter</td>
<td>sunflower seeds, peanut butter, kidney beans,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2 Tbsp or 1/2 oz seeds</td>
<td>lentils, split peas</td>
<td></td>
</tr>
<tr>
<td>Fats and oils/</td>
<td>2</td>
<td>1 tsp soft margarine</td>
<td>Soft margarine, vegetable oil (such as canola, corn,</td>
<td>The DASH study had 27 percent of calories as fat, including fat in or added to foods</td>
</tr>
<tr>
<td>Sweets and added sugars</td>
<td>0</td>
<td>1 tsp vegetable oil</td>
<td>olive, or safflower), low-fat mayonnaise, light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 or less per week</td>
<td>1 Tbsp sugar</td>
<td>salad dressing</td>
<td></td>
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<tr>
<td></td>
<td>1 Tbsp jelly or jam</td>
<td>1 Tbsp mayonnaise</td>
<td>Fruit-flavored gelatin, fruit punch, hard candy,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 cup sorbet, gelatin</td>
<td>2 Tbsp salad dressing</td>
<td>jelly, maple syrup, sorbet, ies, sugar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 cup lemonade</td>
<td></td>
<td>Sweets should be low in fat</td>
<td></td>
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</tbody>
</table>
How large is the gap between current country-level food supply and a “healthy diet” food basket?

Test case: Cameroon – chosen because:

– Cameroon is beginning the 'nutrition transition‘ – needs to deal with both overweight/obesity and micronutrient deficiencies

– Recent nationally-representative dietary data were available

  • improves the specificity of the calculations involving Food Balance Sheet data

  • permits comparisons of adequacy of food supply and adequacy of food consumption
The Dietary Gap Assessment Approach

1. Translate dietary guidelines into a sample hypothetical diet with amounts (kcal) to be consumed from each of 7 food groups.
   – For Cameroon, used WFP benchmark of 2100 kcal/day for total energy intake

2. Use FAO Food Balance Sheet (FBS) data and consumption data for the test country to identify a subset of specific food items for each of the 7 food groups.
   – For Cameroon, chose foods consumed by >5% of participants in a recent national dietary survey
The Dietary Gap Assessment Approach

3. Calculate the quantity (kcal) within each food group that would need to be available in the food supply for all individuals to meet the sample diet.

– For Cameroon, used West African Food Composition Table for energy content of foods
– Selected DASH serving sizes that most closely matched form of foods consumed in Cameroon
– Multiplied # servings in DASH diet X average kcal/serving within each food group
<table>
<thead>
<tr>
<th>country</th>
<th>year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameroon</td>
<td>2011</td>
</tr>
<tr>
<td>Canada</td>
<td>2010</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>2009</td>
</tr>
<tr>
<td>Chad</td>
<td>2008</td>
</tr>
<tr>
<td>Chile</td>
<td>2007</td>
</tr>
<tr>
<td>China</td>
<td>2006</td>
</tr>
<tr>
<td>China, Hong Kong SAR</td>
<td>2005</td>
</tr>
<tr>
<td>China, Macao SAR</td>
<td>2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>item</th>
<th>element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture Items</td>
<td>Total Population</td>
</tr>
<tr>
<td>Alcohol, Non-Food</td>
<td>Production</td>
</tr>
<tr>
<td>Apples and products</td>
<td>Import Quota</td>
</tr>
<tr>
<td>Aquatic Animals, Others</td>
<td>Stock Variations</td>
</tr>
<tr>
<td>Aquatic Plants</td>
<td>Export Quota</td>
</tr>
<tr>
<td>Bananas</td>
<td>Domestic supply</td>
</tr>
<tr>
<td>Barley and products</td>
<td>Feed</td>
</tr>
<tr>
<td>Beans</td>
<td>Seed</td>
</tr>
</tbody>
</table>
# DASH diet for Cameroon

<table>
<thead>
<tr>
<th>DASH Food Groups</th>
<th>Recommendation: kcal/capita/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>396</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>97</td>
</tr>
<tr>
<td>Fruits</td>
<td>201</td>
</tr>
<tr>
<td>Grains (+/- other starchy staple foods)</td>
<td>835</td>
</tr>
<tr>
<td>Meat, poultry, fish and eggs</td>
<td>297</td>
</tr>
<tr>
<td>Nuts, seeds, and legumes</td>
<td>116</td>
</tr>
<tr>
<td>Vegetables</td>
<td>158</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2100</td>
</tr>
</tbody>
</table>
The Dietary Gap Assessment Approach

4. Determine the difference between the estimated national supply (in kcal, edible portion only) of each of the 7 food groups (from FAO FBS data) and the “target” amounts calculated in step #3.

– FBS data include foods produced in and imported to a given country; intended to capture all available food

– For Cameroon, used two scenarios for food group categorization of non-grain starchy foods (roots/tubers and plantains)
  • Scenario 1: roots/tubers in vegetables, plantains in fruits
  • Scenario 2: roots/tubers and plantains in “grains & starchy staples”
Cameroon Food Supply: Vegetables

Scenario 1 (with roots/tubers)
- Cassava and products: 58%
- Roots, Other: 7%
- Yams: 7%
- Vegetables, Other: 8%
- Sweet potatoes: 12%
- Tomatoes and products: 4%
- Potatoes and products: 2%

Scenario 2 (without roots/tubers)
- Vegetables, Other: 55%
- Tomatoes and products: 31%
- Onions: 14%
Cameroon Food Supply: Fruits

Scenario 1 (with plantains)

- Plantains: 36%
- Bananas: 55%
- Fruits, Other: 6%
- Pineapples and products: 3%

Scenario 2 (without plantains)

- Bananas: 79%
- Fruits, Other: 14%
- Pineapples and products: 7%
Cameroon Food Supply:
Grains (and starchy staples)

**Scenario 1: Grains only**
- Maize and products: 34%
- Sorghum and products: 24%
- Rice (Milled Equivalent): 23%
- Wheat and products: 15%
- Millet and products: 0%
- Barley and products: 4%
- Infant food: 0%

**Scenario 2: Grains & starchy staples**
- Maize and products: 22%
- Cassava and products: 19%
- Sorghum and products: 16%
- Rice (Milled Equivalent): 14%
- Wheat and products: 10%
- Millet and products: 7%
- Barley and products: 4%
- Infant food: 2%
- Roots, Other: 0%

- Plantains: 2%

- Other: 0%
The Dietary Gap Assessment Approach

5. Estimate micronutrient content of the sample “healthy diet”, adapted to the target country, and assess whether the sample diet is likely to meet nutrient needs
   – For Cameroon, used National survey of micronutrient status and consumption of fortifiable foods (HKI, Ministry of Public Health, UNICEF, 2011)
   – Chose three target nutrients: Vitamin A, Folate, and Vitamin B12
Results for Cameroon
Dietary Gaps in Cameroon, Scenario 1

(roots/tubers in vegetables; plantains in fruits)

Difference between 2011 FBS Supply & DASH Recommendations

DASH Food Groups

- Dairy
- Fats and oils
- Fruits
- Grains
- Meat, poultry, fish, and eggs
- Nuts, seeds, and legumes
- Vegetables

kcal/capita/day
Dietary Gaps in Cameroon, Scenario 2

(roots/tubers and plantains in “grains & starchy staples”)

Difference between 2011 FBS Supply & DASH Recommendations

DASH Food Groups

kcal/capita/day

Dairy
Fats and oils
Fruits
Grains and starchy staples
Meat, poultry, fish, and eggs
Nuts, seeds, and legumes
Vegetables
Would the DASH diet, adapted to Cameroon, meet nutrient needs?

Estimated percentage of women in Cameroon with inadequate intake of vitamin A, folate and vitamin B12

<table>
<thead>
<tr>
<th></th>
<th>% low based on actual intake</th>
<th>% low if consumed DASH diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>53%</td>
<td>2%</td>
</tr>
<tr>
<td>Folate</td>
<td>59%</td>
<td>22%</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>62%</td>
<td>1%</td>
</tr>
</tbody>
</table>

For DASH diet, % inadequacy calculation assumes 25% CV in intake of that nutrient
Cameroon Food Supply: Fats and oils*

*Although there is no “gap” in total supply of fats and oils, the above fats and oils are not good sources of omega-3 fatty acids.
Limitations

• DASH was originally developed for the US
  – All food-based dietary guidelines based on specific food cultures
  – Beans, nuts and seeds probably under-represented in DASH

• Food Balance Sheet limitations:
  – Account for quantities exported, fed to livestock, used in manufacture and lost during storage and transport, but not wastage at household level
  – Distribution not addressed: FBS capture country-level availability
  – Foods produced at homestead not well captured

• Seasonal variation in supply not considered
Next Steps

• Calculate other nutrient gaps
• Apply approach to other countries
• Evaluate how choices of foods within each food group affect nutrient adequacy
  – E.g. omega-3 fatty acid needs
Conclusions and implications

• Many countries likely have large gaps in supply of animal-source foods, fruits and vegetables to meet “healthy diet” patterns
  – Other recent reports (e.g. Siegel et al. 2014) also document inadequate supply of fruits & vegetables

• Focus on staple food production will not address need for greater dietary diversity and healthier dietary patterns

• How can supply & consumption be shifted towards these goals in the future?
Shifting towards healthier diets: action needed on many fronts

- Production
- Demand
- Waste, postharvest losses
- Inequity in food distribution
Acknowledgments

Dietary Gap Assessment Team:

• Katie Adams
• Mary Arimond
• Joanne Arsenault
• Reina Engle-Stone
• Edye Kuyper
• Steve Vosti

With assistance from Ashley Hanson
Extra slides
Cameroon Food Supply:
Meat, poultry, fish and eggs

- Bovine Meat: 25%
- Pelagic Fish: 17%
- Pigmeat: 14%
- Poultry Meat: 10%
- Mutton & Goat Meat: 8%
- Meat, Other: 8%
- Freshwater Fish: 6%
- Marine Fish, Other: 5%
- Offals, Edible: 4%
- Eggs: 6%
- Demersal Fish: 8%
- Crustaceans: 1%
Cameroon Food Supply:
Nuts, seeds and legumes

- Beans: 35%
- Groundnuts (Shelled Eq): 23%
- Pulses, Other and products: 31%
- Nuts and products: 6%
- Sesame seed: 3%
- Soyabean: 2%
- Palm kernels: 0%
# Dietary Gaps in Cameroon

<table>
<thead>
<tr>
<th>DASH Food Groups</th>
<th>Scenario 1 (plantain in fruits and roots/tubers in vegetables)</th>
<th>Scenario 2 (plantain, roots, and tubers grouped with grains, as starchy staples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>27</td>
<td>396</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>242</td>
<td>97</td>
</tr>
<tr>
<td>Fruits</td>
<td>204</td>
<td>201</td>
</tr>
<tr>
<td>Grains</td>
<td>961</td>
<td>835</td>
</tr>
<tr>
<td>Meat, poultry, fish and eggs</td>
<td>112</td>
<td>297</td>
</tr>
<tr>
<td>Nuts, seeds, and legumes</td>
<td>329</td>
<td>116</td>
</tr>
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<td>Vegetables</td>
<td>483</td>
<td>158</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>2100</td>
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</tbody>
</table>