Estimating Consumption of Agricultural Commodities Using NHANES Dietary Intake Information:

EPA’s Use of the “What We Eat in America” Dietary Consumption Survey

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Outline

• Intro to EPA’s Office of Pesticide Programs (OPP)
• Dietary Exposure Assessment in OPP
  – Exposure Assessment Software and Modeling
• NHANES/WWEIA Food Consumption Survey
• NDL Food Formulation Program
• OPP and “Food Recipes”
  – “Food” to “Food Commodity” Conversions
EPA’s Office of Pesticide Programs

• Registers pesticides used on food crops, in and around the home, for industrial purposes, and for public health protection
• Determines safety of pesticides by assessing dietary and residential/occupational exposures and associated risks
• Establishes legal limits (aka “tolerances”) for pesticides on agricultural commodities
EPA’s Office of Pesticide Programs

• **Dietary (Food + Water) Assessments**
  - Information on pesticide residues in food and water are combined with consumption information to produce distributions of estimated exposures

• **Residential Assessments**
  - Information on use practices, activity patterns, and pesticide concentrations in various residential media are used to produce estimates of exposures in the home

• **Occupational Assessments**
  - Information on application rates, activities, contact rates, and pesticide concentrations are used to assess exposures to mixers/loaders applicators, and re-entry workers
EPA’s Office of Pesticide Programs

• Use of NHANES Data
  – Food Consumption Survey Data (WWEIA)
  – Nutrient Data Laboratory Food Formulation Software
  – Pesticide Bio-monitoring Data
Dietary Risk Assessment: *Estimating Exposure*

- Dietary exposure estimates are derived from two distinct pieces of information:
  - The amounts of foods people eat:
    - USDA’s Continuing Survey of Food Intake by Individuals (CSFII) 1994/96/1998
    - NHANES “What We Eat in America”
    - NDL Estimates for Ingredients in commercial foods
  - The amount of pesticide in and on food (i.e., pesticide residues)
    - field trial data
    - monitoring data
      - USDA PDP
      - FDA
    - market basket survey
Exposure Assessment Software and Modeling

• OPP uses a number of software models to perform its risk assessments:

  DEEM-FCID/Calendex

  SHEDS-Multimedia

• Dietary Exposure Equation:

  \[
  \text{Dietary Exposure} = \sum_{i=1}^{n} (\text{Consumption}_i \times \text{Unit Conversion} \times \text{Residue}_i)
  \]

  where \( n \) = number of unique foods (or food commodities) consumed
Exposure Assessment Software and Modeling

• The modeling tools rely on probabilistic techniques (Monte-Carlo) to evaluate exposure
  • Techniques are routinely applied by OPP for virtually all of its pesticide risk assessments
  • More accurate estimates of entire range of exposures and their associated probabilities

• Allow the Agency to characterize and quantify the variability in dietary exposure across various subgroups of interest
Conversion of **Food**
to **Food Commodities**

Food Consumption
(in gram amounts)

\[ X \]

Recipes
(aka 100 gram files)

↓

**Food Commodity** Consumption
### Reported Amounts Consumed

#### Example CSFII Food Diary (28517-2-2)
(1 yr Male, 13.6 kg bwt (30 lbs), Height=28”, healthy, no food allergies)

<table>
<thead>
<tr>
<th>SEQN</th>
<th>Time of Day</th>
<th>Food Description</th>
<th>Amount (unit code)</th>
<th>Consumption (gm)</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7:00 AM</td>
<td>Milk, cow's, fluid, whole</td>
<td>6 fl.oz (10205)</td>
<td>183</td>
<td>Store</td>
</tr>
<tr>
<td>2</td>
<td>10:15 AM</td>
<td>Egg, whole, fried W/ LARD</td>
<td>2 XX (60919)</td>
<td>92</td>
<td>Store</td>
</tr>
<tr>
<td>3</td>
<td>10:15 AM</td>
<td>White potato, home fries W/ LARD</td>
<td>2 C (10205)</td>
<td>388</td>
<td>Store</td>
</tr>
<tr>
<td>4</td>
<td>6:00 PM</td>
<td>Chicken, drumstick, with or without bone, roasted, skin eaten</td>
<td>1 XX (61343)</td>
<td>52</td>
<td>Store</td>
</tr>
<tr>
<td>5</td>
<td>8:00 PM</td>
<td>White potato, home fries W/ LARD</td>
<td>1-2 C (10205)</td>
<td>388</td>
<td>Store</td>
</tr>
<tr>
<td>6</td>
<td>8:00 PM</td>
<td>Milk, cow's, fluid, whole</td>
<td>6 fl.oz (10205)</td>
<td>183</td>
<td>Store</td>
</tr>
</tbody>
</table>
# Recipe for “White potato, home fries with lard (71403000-200001)”

<table>
<thead>
<tr>
<th>RAC Code</th>
<th>Commodity (RAC)</th>
<th>Food Form (CSFFCM)</th>
<th>Food Form Description</th>
<th>Grams Per 100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>01032990</td>
<td>Potato, tuber, w/peel</td>
<td>213</td>
<td>Fresh, Fried</td>
<td>82.6</td>
</tr>
<tr>
<td>03002370</td>
<td>Onion, dry bulb</td>
<td>213</td>
<td>Fresh, Fried</td>
<td>10.2</td>
</tr>
<tr>
<td>19022740</td>
<td>Pepper, black and white</td>
<td>213</td>
<td>Fresh, Fried</td>
<td>0.034</td>
</tr>
<tr>
<td>25002930</td>
<td>Pork, fat</td>
<td>213</td>
<td>Fresh, Fried</td>
<td>6.8</td>
</tr>
</tbody>
</table>

White potato, home fries with Lard (71403000-200001)
What We Eat in America (WWEIA)

- What We Eat in America (WWEIA) is the dietary intake interview component of the National Health and Nutrition Examination Survey (NHANES).
- Nationally Representative/Statistically-Based
  - Intakes of individuals residing in 50 states and D.C.
- Data released in 2-year cycles
- Contains Food Consumption Data for ~ 7000 foods
  - Unique 8 digit food code
- Oversampling of various subpopulations
- Consisted of:
  - 2 non-consecutive days
    - DAY 1: in-person 24 hour recall at MEC
    - DAY 2: telephone interview (ca. 3-10 days later)
WWEIA Data Files

For each 2-year data release cycle, two dietary intake data files are available…

1) Total Nutrient Intakes File –
   • Contains one record per day for each survey participant.
   • Each record contains details of intake of food and water and daily totals of nutrient intakes

2) Individual Foods File –
   • Contains one record per food for each survey participant
   • Day 1 and Day 2 are in separate files (must be combined)
   • Foods are identified by USDA WWEIA food codes.
   • Each record contains information about
     – when and where the food was consumed,
     – whether the food was eaten with other foods,
     – amount eaten, and
     – amounts of nutrients provided by the food.
Nutrient Values for WWEIA

• NDL develops and maintains the National Nutrient Database for Standard Reference
• Values for 65 components are obtained from analytical projects, the food industry, or standard calculations (e.g., factors, formulations, recipes)
• Database of 3000 foods is released to FSRG
• Foods eaten “as is” and as food ingredients
This is a recipe in the FNDDS-SR-LINK. Sometimes in the FNDDS there is a one to one link between an FNDDS code and a single SR item code. In other cases, the nutrient profile is calculated by FSRG from SR ingredients.
Recipes

• Hence, need to convert WWEIA from an “as eaten” food basis (e.g., pizza, hamburgers, etc.)

  to

  a food commodity basis (e.g., tomato sauce, wheat flour, apples, soybean oil, beef, milk, etc.)

• Conversion performed by means of standard recipe (aka “100 gram”) files to produce a parallel food commodity database
  – Food Commodity Intake Database (FCID)
Nutrient Data Lab’s Recipe and Formulation Tools

• Recipe - A recipe is the list of ingredients and their known weights or measures in a multi-ingredient food item. Final item is adjusted for “yield” and nutrient retention

• Formulation - A formulation is the estimated weight of ingredients in a multi-ingredient commercial food item
NDL Formulation Estimations Will Assist the OPP

- If there is an FNDDS food code that links to a single SR item that is a multi-ingredient food (e.g. apple pie)

- If label ingredients are available for the SR item
Formulation Estimation Process

Select SR ingredients that best match the industrial ingredients

Select some known nutrient values for the food item as ‘Program Targets’

Select SR items that best match the label ingredients

Add additional guidance to the program to assist it in estimating the percentage of each ingredient and calculating nutrient values based on these percentages (i.e. use nutrient values from the ingredients to calculate final, estimated, nutrient values for the commercial product). Each nutrient estimation is a weighted mean of the ingredient nutrient values.
Selected nutrients are targeted for best-fit matching

Folic acid targeted as best indicator of flour %

Total model error is the summation of the absolute value of individual model errors of the nutrients targeted for matching
Final Formulation Estimation

[Image of a computer interface showing a food formulation database with ingredients listed and their properties such as rank, food item identifier, NDB number, edited name, ingredient description, whole grain, lower bound, exact amount, upper bound, relax order, estimated %W, fat loss, etc.]
NHANES-FCID

- Will be based on WWEIA and SR Procedures
- Food “as-eaten” translated to agricultural (food) commodities (EPA food vocabulary)
- Foods commodities also coded for:
  - Cooked status (e.g., Cooked, Uncooked)
  - Food form (Fresh, Frozen, etc.)
  - Cooking method (Baked, Boiled, etc.)

- **Approximately 570 food commodities**
  - From ca. 7000 foods in WWEIA
  - 8 digit *food commodity* code
    - E.g., 01032990 = Potato, tuber, w/ peel
Future Plans/Directions

• Complete FCID-NHANES 99+
  – Comparison with 1994-96/1998 FCID
  – Eating occasion basis

• US EPA’s Exposure Factors Handbook
  – Electronic files

• Eating Patterns
  – Seasonal Consumption Patterns??
  – Geographic Consumption Patterns??

• International Comparisons/Databases
Conclusions

• The resulting food commodity consumption database (FCID) derived from WWEIA and NDL procedures will be incorporated into OPP’s pesticide exposure models as a replacement for the current CSFII data
For Further Information…

Available Information for Assessing Exposure to Pesticides in Foods

A Users Guide


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Thank you!