Using the Remote Food Photography Method to Measure Children's Dietary Intake in the Preschool Setting

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Today’s Presentation

• The Remote Food Photography Method© (RFPM)
  – The RFPM process and the SmartIntake® App
  – Validation studies among children
• Collecting RFPM Data via Video in Head Start
• Results from Mealtime Matters
• Q&A
Food photography: A brief history

• Direct visual estimation of food intake in schools has a long history, dating back to the 1980’s (Comstock, EM et al., JADA, 1981)
  – Direct visual estimation of food intake has many advantages, and some disadvantages
    • Trained raters must be present in the dining location
    • Throughput is limited and can disrupt the dining environment, particularly in school cafeterias
    • Although some processes are less obtrusive, participants frequently see the human rater evaluating their food selection and plate waste; thus, reactivity can occur
Food photography as an evolution of direct visual estimation

• Don Williamson and team sought to:
  – Quickly and unobtrusively collect video of food selection and plate waste, and rate the images later with visual estimation
  – Increase throughput and not disrupt the dining environment
Digital Photography of Foods

- Data are quickly captured via video
- Raters use the Food Photo. App.© to calculate intake based on the USDA database
- Error is +5.2 g vs. weighed intake

Williamson, DA et al., *JADA* 2003; *Eat, & Wt. Disord.* 2004
The Remote Food Photography Method© and SmartIntake® app

Martin et al., BJN, 2009; IEEE, 2009; Obesity, 2012; Dibiano, et al., 2013
R21 AG032231, R01 DK089051
Table 2. Descriptive statistics and test of differences between the rater method and the weighed method for food amount and nutrient intake in 54 Hispanic and African-American minority preschool children who participated in a 12-hour observation to validate the intake estimations made using a digital photography method.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rater Method Mean±SD(^a)</th>
<th>CV(^b) %</th>
<th>Weighed Method Mean±SD</th>
<th>CV, %</th>
<th>DIF(^c) Mean±SD</th>
<th>CV, %</th>
<th>t Test(^d) P value</th>
<th>95% CL</th>
<th>MPE(^f) mean±SD</th>
<th>AMPE(^g) mean±SD</th>
<th>RMSE(^h)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food amount</strong></td>
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<tr>
<td>Served, g</td>
<td>1,996±209.5</td>
<td>10.5</td>
<td>1,918±188.3</td>
<td>9.8</td>
<td>77.9±96.5</td>
<td>123.8</td>
<td>&lt;0.0001</td>
<td>51.6</td>
<td>1.1</td>
<td>4.1±5.1</td>
<td>5.4±3.8</td>
</tr>
<tr>
<td>Plate waste, g</td>
<td>892.5±33.5</td>
<td>37.4</td>
<td>848.6±330.7</td>
<td>39.0</td>
<td>43.9±61.6</td>
<td>140.2</td>
<td>&lt;0.0001</td>
<td>27.1</td>
<td>51.8</td>
<td>6.2±11.4</td>
<td>9.8±8.5</td>
</tr>
<tr>
<td>Intake, g</td>
<td>1,103±322.8</td>
<td>29.3</td>
<td>1,069±296.9</td>
<td>27.8</td>
<td>34.0±71.0</td>
<td>208.7</td>
<td>0.001</td>
<td>14.6</td>
<td>59.7</td>
<td>2.9±6.6</td>
<td>5.7±4.3</td>
</tr>
<tr>
<td><strong>Nutrient intake</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Energy, kcal</td>
<td>1,102±304</td>
<td>27.6</td>
<td>1,027±279</td>
<td>27.2</td>
<td>75.1±108</td>
<td>135.5</td>
<td>&lt;0.0001</td>
<td>47.3</td>
<td>85.5</td>
<td>7.5±10</td>
<td>9.6±8</td>
</tr>
<tr>
<td>Energy density, kcal/g</td>
<td>1.0±0.2</td>
<td>17.5</td>
<td>1.0±0.2</td>
<td>17.5</td>
<td>0.1±0.1</td>
<td>210.4</td>
<td>0.001</td>
<td>0.0</td>
<td>0.1</td>
<td>6.5±12.1</td>
<td>10.0±9.4</td>
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<tr>
<td>Protein, g</td>
<td>39.6±14.4</td>
<td>36.4</td>
<td>35.5±12.8</td>
<td>36.2</td>
<td>4.0±4.6</td>
<td>114.0</td>
<td>&lt;0.0001</td>
<td>2.8</td>
<td>3.9</td>
<td>11.7±12.1</td>
<td>14.1±10.5</td>
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<tr>
<td>Carbohydrate, g</td>
<td>169.2±47.2</td>
<td>27.9</td>
<td>161.2±41.9</td>
<td>26.0</td>
<td>8.0±15.4</td>
<td>191.8</td>
<td>0.000</td>
<td>3.8</td>
<td>12.9</td>
<td>4.6±10.0</td>
<td>8.8±6.6</td>
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<tr>
<td>Fat, g</td>
<td>30.6±11.7</td>
<td>38.1</td>
<td>28.6±10.6</td>
<td>37.0</td>
<td>2.0±5.2</td>
<td>258</td>
<td>0.006</td>
<td>0.6</td>
<td>4.4</td>
<td>7.7±18.8</td>
<td>14.8±13.9</td>
</tr>
</tbody>
</table>

\(^a\)SD=standard deviation.  
\(^b\)CV=coefficient of variation.  
\(^c\)DIF=difference between rater and weighed methods.  
\(^d\)Paired t test.  
\(^e\)CL=confidence limits (lower CL, upper CL).  
\(^f\)MPE=mean percent error; calculated as [(rater method−weight method)×100/weight method].  
\(^g\)AMPE=absolute mean percent error.  
\(^h\)RMSE=root mean square error.

Gram Intake: +2.9 mean % error.  
Kcal intake: +7.5% (sig. Bland and Altman)
-15.6% (consistent) error

Nicklas et al., *Obesity*, 25; 2017
Collecting RFPM Data via Video in Head Start
Challenges with Food Photography in CACFP Settings

• Family-style dining = lots of servings of food
• RAs concerned they could not capture eating for more than 2-3 children
• The number of RAs needed becomes unwieldy
  – Disruptive to teachers
  – Disruptive to students, potentially altering eating
  – Difficult to staff, particularly if data collection occurs over a short period and/or at a distant location
Basics of video recording meals

- GoPro cameras with single leg tripod with weighted base
- Cameras need to capture plates at 45 degree angle
- Surround table with cameras so all place settings are captured
- Different room/table layouts require different solutions
In classroom recording process

• Set up cameras around empty tables, turn cameras on
• Give children name tag with study ID
• Children sit at table, table is set for meal
• RFPM cards taped to index card with each child ID noted
• RFPM cards placed next to each child’s place setting
• RAs monitor if cameras are moved
Post-recording image processing

• Goal: From videos, create still images of every pre-eating plate/cup and post-eating plate/cup

• Train RAs to reliability on identifying timing of pre- and post-eating

• RAs also annotate every image with what was on the plate and any activity not well-captured in the image

• RAs make at least 2 passes of video, first to identify timing, second to “screen shot” pre- and post-eating and annotate image

• Lead RA reviewed 10% of RAs work to ensure accuracy
Ate chicken balls and ketchup to plate. Reference card is blocked by cup.

Ate approx. one half of chicken ball with ketchup. Ketchup blocked by serving bowl.

Ate one bite of chicken ball with ketchup.

Ate one goldfish cracker from bag on table in front of her.

Ate one goldfish cracker from bag on table in front of her.

Ate one goldfish cracker from bag on table in front of her.

Ate apple. Approx. 7 goldfish crackers, chicken and ketchup. Drank milk. Classroom lights were turned off just after this photo.

Ate apple. Approx. 10 more goldfish crackers, several bites of apple, one additional bite of chicken ball with ketchup. Did not eat any corn.
Lessons Learned

• Teacher buy-in is critical

• Some food never ends up on the children’s plates, careful observation is essential

• Longer videos were more difficult for RAs to keep focused on

• Children with many screenshots were eating/drinking only small amounts of food. High accuracy may not have changed intake measurements very much
Children’s Lunch Intake

Kilocalories

<table>
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<th></th>
<th>IOM Target</th>
<th>Taken</th>
<th>Consumed</th>
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<tbody>
<tr>
<td>Kilocalories</td>
<td>300</td>
<td>500</td>
<td>400</td>
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Children’s Lunch Intake

<table>
<thead>
<tr>
<th></th>
<th>CACFP target</th>
<th>Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit (cups)</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Vegetable (cups)</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Meat/meat alternative (oz)</td>
<td>1.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>
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Disclosures

• Louisiana State University / Pennington Biomedical Research Center have an interest in the intellectual property surrounding the Remote Food Photography Method© (RFPM) and SmartIntake® app and C. Martin (among others) is an inventor of the technology
Questions?
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