Outline

- Why Count Carbs?
- Carb counting intervention research with type 1 adults
- Carb counting accuracy research on type 1 children/adolescents
- Carb counting intervention study with type 1 adolescents at the BDC
Why Count Carbs?

**DCCT**: using insulin/CHO ratios in intensively treated group improved glycemic control

**ADA**: Monitoring of CHO whether by CHO counting, exchanges, or experienced-based estimation remains a key strategy in achieving glycemic control

(Diabetes Care 2008)
CHO Counting Intervention Data

- DAFNE study: 169 Type 1 Adults (UK): course teaching flexible intensive insulin treatment combining dietary freedom and insulin adjustment (5 day course taught by RD and RN)
  - Improved HbA1c at 6 months (9.4% v. 8.4%, p<0.0001)
  - Improved ‘quality of life’ at 12 months
  - At 44 months HbA1c and QOL continued to show sig improvement (101 subjects)

DAFNE, BMJ Oct 2002
Speight, Diabetes Res and Clin Pract April 2010
256 Type 1 Adults (39 ± 11 years) (Italy) using MDI

Randomized to Nutrition Education Program (MNT and CHO counting)

4 week multidisciplinary training (MD, nutritionist, psychologist)

At 9 months f/u – intervention group had significant decrease in HbA1c (P<0.01) and hypoglycemic events compared to controls (p<0.05)

BolusCal Study

- 51 adults with type 1 (18-65 yo) in poor control (HbA1c 8-10.5%) using MDI (Denmark)
- Randomized, controlled 16 week study
- 3 arms: control, carb counting and carb counting with bolus calculator
- 3 hour class with diabetes nurse educator and RD, 1 hour f/u and two 15 min telephone consults
- Sig change in HBA1c within groups for carb count (-.8%) and boluscal (-.7%) groups
- Sig improvement in satisfaction in both treatment arms (more pronounced in boluscal arm)

CHO Counting Intervention Data

- 56 Type 1 Adults (18-65 yo) using CSII >3 months (Italy)
- Randomized prospective trial
- All attended group lesson with dietitian about recommended diet for diabetes
- Intervention: 4 to 5 1:1 sessions with RD and MD (diabetologist) over 12 weeks
- Taught to use I:C ratio and bg correction

Laurenzi et al, Diabetes Care, 34, 823-27, April 2011
Results (24 weeks)

- Intervention group had:
  - Sig improvement in DSQOLS score related to dietary restrictions (P=0.004)
  - Sig reduction in BMI (P=0.020) and waist circumference (P=0.007)
  - Sig reduction in HbA1C in those who continuously used CHO counting (-0.35% vs control subjects, (P=0.05))
31 children and adolescents (9.5-16.8 years) using CSII or MDI (Australia, UK)
50, 60, 70 gm carb test lunches
Used same dose for each meal with usual I:C ratios
No diff in mean postprandial bg for MDI vs CSII
No diff in bg or AUC for 2.5 hours
70 gm meal produced higher glucose excursions after 2.5 hours but bg remained in target range

CHO Counting Accuracy in Peds

- 34 youth with type 1 dm (8.5-18 yo) using MDI or CSII (Australia) A1c ≤8%
- 5 test breakfasts with 40, 50, 60, 70, 80 gm carb
- Used same dose for each meal using usual I:C ratio for 60 gm carb
- 40 gm meal resulted in sig more hypoglycemia and bg levels were sig higher for the 80 gm carb meal than 60 or 70 gm carb at 2 and 3 hour post-meal

In order to maintain postprandial control, CHO estimation should be within 10 gm of actual meal CHO

Smart, Diabetic Medicine 2012.
Impact of Carbohydrate Counting on Glycemic Control in Children with T1D

- **67 Parents** of children (4-12 years) using CSII or MDI (Joslin)
- CHO counting was assessed using 3 diet recalls conducted by RD
- Parent estimates were 120% of nutrition database calculation
- More precise (consistent), but not accurate carbohydrate counting was associated with lower HbA1C in children with T1D (P=0.02)

CHO Counting Accuracy Data

- 102 Children and Adolescents (8-18 yo) and 110 Caregivers using MDI or CSII (Australia and UK)
- Estimated CHO content of 17 standardized meals containing 8-90 gm CHO
- 73% of all estimates were within 10-15 gm of actual CHO content, 43% were within 5-7 gm
- Overestimation of snacks and underestimation of large meals

Smart et al, Diabetic Medicine 27, 348-353, 2010
Carb Counting Accuracy Data

- No association between accuracy and HbA1c
- The longer duration of CHO counting the greater the error
- Unlabeled foods were the major source of error
- Counting in gram increments was not better than estimations in 10gm portions or 15 gm exchanges
Carbohydrate Counting in Adolescents with Type 1 diabetes (CCAT) study (BDC)

- Subjects recorded their estimate of portion size, carbohydrate content, and frequency of consumption.
- Subjects assessed the carbohydrate content for 32 foods commonly consumed by youth.
- Food presented as food models or actual food in common serving sizes or self-served by subject.

Results

- Study participants: n=48, age=15.2±1.8, HbA1c=8.0±1.0%

- For each meal, accuracy categorized as “accurate (within 10 g)”, “overestimated (by>10 g)”, “or underestimated (>10 g).”

- For dinner meals, subjects with “accurate” estimate of carbohydrates had the lowest HbA1c (7.7±1.0%) compared to HbA1c of 8.5±1.2% and 7.9±1.0% for “overestimated,” and “underestimated,” respectively (p=0.04)

Results

Statistically significant overestimation observed for 15 of 32 foods (including syrup, hash browns, rice, spaghetti, and chips).

Statistically significant underestimation observed for 8 of 32 foods (including cereal, French fries, and soda).

Adolescents with T1DM do not accurately count carbohydrates and commonly either over or underestimate carbohydrates in a given meal.
Nutrition Education and Intervention Study (BDC)

- Adolescents (ages 12-18) with type 1 diabetes, seen at the BDC, carb counting for at least 1 meal/day
- Randomized to control or intervention group

Methods

Baseline Visit/Final Visit (3 mos)

- Subjects assessed the carbohydrate content for foods/meals commonly consumed by youth. (SEARCH data, food records from BDC)

- Subjects recorded their estimate of portion size, carbohydrate content, and frequency of consumption.

- Food presented as food models or actual food in common serving sizes or self-served by subject.
Instructions for Carbohydrate Quiz

Carbohydrate Counting in Adolescents with Type 1 Diabetes (CCAT) Study

Please look over the examples below which explain how to complete the food "quiz" form.

<table>
<thead>
<tr>
<th>Meal</th>
<th>Estimated serving size</th>
<th>Estimated carbohydrate content</th>
<th>About how often do you usually eat this food? (please &quot;X&quot; one)</th>
<th>Times/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: Mini Twist Pretzels</td>
<td>Pretzels: 18 pretzels</td>
<td>Pretzels: 23 g</td>
<td>&lt; 1/month 1-3/month 1-2/week 3-5/week Almost every day</td>
<td></td>
</tr>
<tr>
<td>Example: Frozen bean and cheese burrito</td>
<td>Burrito: 1 burrito</td>
<td>Burrito: 56 g</td>
<td>&lt; 1/month 1-3/month 1-2/week 3-5/week Almost every day</td>
<td>X</td>
</tr>
<tr>
<td>Example: Apple sauce</td>
<td>Apple sauce: ½ cup or 4 oz.</td>
<td>Apple sauce: 20 g</td>
<td>&lt; 1/month 1-3/month 1-2/week 3-5/week Almost every day</td>
<td>X</td>
</tr>
</tbody>
</table>

If there is a label on any of the food items, you can use this label to help you. If you have any questions during the study visit, please ask.

Have fun looking over all the different kinds of food. You will not be graded on this. You are helping us learn more about carbohydrate counting and type 1 diabetes. Thank You!!!
<table>
<thead>
<tr>
<th>Food Item</th>
<th>Estimated serving size</th>
<th>Estimated carbohydrate count</th>
<th>About how often do you usually eat this food? (please check one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peanut butter and jelly sandwich</td>
<td>1 slice</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Peanut Butter</td>
<td>1 slice</td>
<td>10</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>10</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>10</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>10</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>10</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Jelly (regular)</td>
<td>1 slice</td>
<td>20</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>20</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>20</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>20</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>20</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Apple</td>
<td>1 slice</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Dinner</td>
<td>1 slice</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td>Spaghetti with marinara and side broccoli</td>
<td>1 slice</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>30</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Marinara (red spaghetti sauce)</td>
<td>1/2 cup</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1/2 cup</td>
<td>30</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1/2 cup</td>
<td>30</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1/2 cup</td>
<td>30</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1/2 cup</td>
<td>30</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1 slice</td>
<td>4</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>4</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>4</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>4</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 slice</td>
<td>4</td>
<td>Almost every day</td>
</tr>
<tr>
<td>Diet Snapple</td>
<td>1 can</td>
<td>30</td>
<td>&lt; 1/month</td>
</tr>
<tr>
<td></td>
<td>1 can</td>
<td>30</td>
<td>1-3/month</td>
</tr>
<tr>
<td></td>
<td>1 can</td>
<td>30</td>
<td>1-2/month</td>
</tr>
<tr>
<td></td>
<td>1 can</td>
<td>30</td>
<td>3-5/month</td>
</tr>
<tr>
<td></td>
<td>1 can</td>
<td>30</td>
<td>Almost every day</td>
</tr>
</tbody>
</table>
Methods

- Adolescents screened and qualified for the randomized trial if they were inaccurate by more than 10 gm from actual carb amount on 4 out of 6 meals.
- Those who qualified were randomized to control or intervention - both received a brief (5 min) review of carb content in foods and carb counting resources.
- Given RD phone # and instructed to call with questions.
Intervention Group

- Attended one 60-90 min class with RD/CDE (1-2 participants)
- Interactive/Hands on activities directed at the adolescent
- Label reading, estimating portions using real foods, food models, calculating doses, restaurant eating, school lunch
- Received Calorieking book, food scale and dry measuring cups
Intervention

- Completed 2 sets of 3 day food records and received phone feedback on CHO counting accuracy and insulin adjustments.
Results

- Screened 101 adolescents, 66 qualified
- Overestimated 16 of 29 foods including cereal, milk, carrots, chicken nuggets, Goldfish crackers, cheese and waffles
- Underestimated 5 of 29 foods including banana, fries, barbecue sauce and regular soda
- Over or Underestimated 10 of the 14 meals and snacks

Results

- No significant change in CHO counting accuracy from baseline to f/u in either group
- HbA1c decreased in both the intervention and control groups, but the overall intervention effect was not significant
- Adolescents who collaborated more with their parents had lower HbA1c
- No association between duration of cho counting and accuracy

# HBA1c Levels

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>F/u</th>
<th>Change</th>
<th>p</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>8.41±0.19</td>
<td>8.22±0.18</td>
<td>-0.19±0.12</td>
<td>0.12</td>
<td>0.49</td>
</tr>
<tr>
<td>Control</td>
<td>8.25±0.19</td>
<td>8.17±0.18</td>
<td>-0.08±0.11</td>
<td>0.51</td>
<td></td>
</tr>
</tbody>
</table>

Summary

- Intervention research in adults indicates that carb counting can help improve quality of life and HbA1c.
- Adolescents need help in improving carb counting accuracy.
- More intervention research is needed, especially in adolescents and children.
Thank You!