Medical Nutrition Therapy for Diabetes: Introduction

Marion J. Franz, MS, RD, CDE
Minneapolis, MN
Change in the Emphasis of Nutrition Therapy for Diabetes

- Previous guidelines attempted to apply one “ideal” nutrition prescription to everyone with diabetes
- Emphasis has been on macronutrients -- ideal percentages for carbohydrate, protein, and fat
- Today, emphasis is on goals and nutrition-related strategies to achieve these goals
Glycemic Control

**Evidence-Based**
- Preventing hyperglycemia prevents complications (DCCT and UKPS)
- Nutrition therapy is integral and essential
- Integrate insulin therapy into eating and exercise habits
- Type 2 diabetes: emphasize blood glucose control, not weight loss

**Unknown**
- How to prevent weight gain
- How to prevent and treat hypoglycemia

©2000 University of Pennsylvania School of Medicine
Blood Glucose Target Range

Non-pregnant Adults

- Pre-meal glucose: 80 - 140 mg/dL
- 2 hour post-meal glucose: <180 mg/dL
- Bedtime glucose: 100 - 160 mg/dL
- Hemoglobin A\textsubscript{1C}: < 7%

Strive for 50% of readings in range
Goals for Patients with Diabetes

- Near-normal blood glucose levels
- Optimal lipid levels
- Appropriate calories
  - Reasonable weight for adults
  - Growth and development for children and teens
- Improved health through optimal nutrition and physical activity
- Individualized based on usual lifestyle habits and need/willingness to change
Medical Nutrition Therapy for Diabetes: Nutrition Strategies for Type 1 Diabetes

Marion J. Franz, MS, RD, CDE

Minneapolis, MN
Persons Using Insulin

- Develop meal plan based on usual eating and exercise habits
- Integrate insulin regimen
- Eat consistently
- Monitor and write down blood glucose results
- Adjust insulin doses based on carbohydrate choices and blood glucose patterns
- Add algorithms
Meal Carbohydrate and Insulin Requirements in Type 1 Diabetes

• High- (55%) and low- (40%) carbohydrate diets were compared in intensively treated persons

• Amount of carbohydrate in the meal does not affect glycemic control, if premeal insulin is adjusted appropriately

• Premeal insulin algorithms are valid; variations in carbohydrate do not modify basal ultralente insulin

• Variations in meal glycemic index, fiber, fat, or caloric intake do not influence premeal insulin

Preventing Weight Gain in Type 1 Diabetes

- Integrate insulin therapy into eating and exercise habits to prevent weight gain and hypoglycemia
- Appropriate treatment of hypoglycemia and adjustments for exercise
- Can not ignore protein and fat content, even with carbohydrate counting (meat portions and fat servings add up!!)
Medical Nutrition Therapy for Diabetes: Obesity and Chronic Disease

Marion J. Franz, MS, RD, CDE
Minneapolis, MN
Does Obesity Kill or Simply Offend?
Gina Kolata, New York Times

Losing Weight--An Ill-Fated New Year’s Resolution
Obesity and Excess Mortality

- 6,193 obese pts (BMI 25-74) followed for 14 yrs
- Morbid obesity (BMI >40): strong predictor of premature death
- Gross obesity (BMI 32 to <40): excess mortality risks considerably lower than previously assumed
- Moderate obesity (BMI 25 <32): not significantly associated with excess mortality
- BP, glucose intolerance, diabetes, smoking, significant independent mortality risk factors, cholesterol was not

BMI Not Associated with Mortality in Type 2 Diabetes

- WHO Multinational Study: “BMI has no clear effect on mortality, even when adjusted for confounders such as smoking, insulin treatment, and the presence of retinopathy, or for variables that may be influenced by weight such as blood pressure and cholesterol.”

BMI Not Associated with Micro- and Macrovascular Complications

- The Wisconsin Epidemiologic Study of Diabetic Retinopathy: “Body mass index was not associated with progression of retinopathy, incidence of gross proteinuria, amputation of a lower extremity, or death due to ischemic heart disease. Obesity is not related to the long-term incidence of micro- and macrovascular complications.”

BMI Not Associated with Coronary Artery Disease in UKPDS

- United Kingdom Prospective Diabetes Study Group (UKPDS): Risk factors for coronary artery disease in type 2 diabetes: increased levels of LDL-cholesterol, decreased HDL-cholesterol, raised blood pressure, hyperglycemia, and smoking.

- Variables not associated with CAD: BMI, waist-hip ratio, decreased physical activity, raised insulin concentrations.

Weight Loss and Type 2 Diabetes

- Majority of health professionals believe weight loss to be beneficial for persons at risk for chronic diseases, especially type 2 diabetes
- Obesity is associated with insulin resistance, hyperinsulinemia, and glucose intolerance
- Success at helping individuals maintain weight long-term has been dismal
- Treatment strategies for a chronic disease may not be the same as prevention strategies
Treating Type 2 Diabetes: Focus on Blood Glucose Control not Weight Loss

- Improving blood glucose control is a higher priority than weight loss
- Once a chronic disease develops, nutrition therapy should focus on correcting associated metabolic abnormalities
- Reasonable body weight—the weight an individual and health professional determine is achievable short- and long-term
- Prevention of type 2 diabetes:
  - Physical activity
  - Sustained weight loss of 8 to 15 lb
Medical Nutrition Therapy for Diabetes: Nutrition Strategies for Type 2 Diabetes

Marion J. Franz, MS, RD, CDE

Minneapolis, MN
Strategies for Type 2 Diabetes

- Monitor glucose levels; add medications, if needed
- Physical activity
- Moderate weight loss
- New eating behaviors
- Carbohydrate Counting
- Reduce fat intake
- Energy restricted diets
- Smaller, more frequent meals

Blood glucose and lipid control
Weight Loss Does Not Always = Improved Blood Glucose Control

• 135 obese with type 2 diabetes who had lost 20 lb.
• Studied retrospectively to identify predictors of BG response
  ➢ 80 (59%) non-responders (BG = 300 mg/dL)
  ➢ 55 (41%) responders (BG = 125 mg/dL)
• Effect of diet can be predicted from BG <180 mg/dL after weight loss of 5-10 lb.

(Watts, et al., Arch Intern Med 1990)
Plasma Glucose Levels in Responders and Nonresponders Initially and After Weight Loss

Reducing Calories And Moderate Weight Loss Improves Glycemia

• Calorie restriction
  ➢ Early glycemic improvements
  ➢ Related to changes in macronutrient content (reduced carbohydrate intake)
  ➢ Decreased hepatic glucose output

• Moderate weight loss
  ➢ Later improvement in glycemia
  ➢ Decreases abdominal fat
  ➢ Increases insulin sensitivity and improves lipids

Meal Frequency

- Increased meal frequency may minimize postmeal hyperglycemia
- Also improves insulin and FFA levels
- Six small meals appears adequate for effect
- No significant effects of meal frequency in long-term study

(Bertlesen et al. Diabetes Care 16:3, 1993)
(Arnold et al. Diabetes Care 20:1651, 1997)
Benefits of Exercise for Type 2 Diabetes

• Improves glucose tolerance due to an increase in insulin sensitivity
  ➢ Activates intracellular Glut 4 glucose transporters improving peripheral glucose uptake
  ➢ Suppresses hepatic glucose production

• Most effective in persons with BG <200 mg/dL or with impaired glucose tolerance

• Lowers risk and may even prevent type II diabetes
## Two Approaches to Fitness

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency:</strong></td>
<td>3 - 4 days/week</td>
<td>Physical activity everyday</td>
</tr>
<tr>
<td><strong>Intensity:</strong></td>
<td>65 - 85% of max heart rate</td>
<td>Moderate intensity (brisk walking)</td>
</tr>
<tr>
<td><strong>Time:</strong></td>
<td>Minimum 20 min/session</td>
<td>Accumulate 30 min or more everyday</td>
</tr>
</tbody>
</table>

©2000 University of Pennsylvania School of Medicine
Can medical nutrition therapy for Type 2 Diabetes lead to successful clinical outcomes?
Effectiveness of Nutrition Therapy Provided by RDs

- Positive effect on clinical outcomes
  - ~1-2% decrease in HbA$_{1C}$
- Outcome known by 6 weeks to 3 months
- Longer duration of diabetes, did significantly better with intensive nutrition therapy
- All therapies work better with a food plan

(Franz et al. J Am Diet Assoc 1995)
Effectiveness of Medical Nutrition Therapy Provided by Dietitians in the Management of Type 2 Diabetes: A Randomized, Controlled Clinical Trial

(Franz et al., J Am Diet Assoc 95:1015, 1995)
RN/RD Consult Program: Emphasis on CHO Counting, Not Weight Loss

HbA$_{1c}$ Changes*

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>3rd Month</th>
<th>6th Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>8.7</td>
<td>6.6</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Weight Loss*

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>3rd Month</th>
<th>6th Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>227</td>
<td>218</td>
<td>218</td>
</tr>
</tbody>
</table>

*p<0.0001, n=69 (49 of 69, 71% lost weight)

(Rickheim, et al. IDC 1999)
Medical Nutrition Therapy for Diabetes: Carbohydrate

Marion J. Franz, MS, RD, CDE
Minneapolis, MN
Carbohydrate

**Evidence-Based**
- Total carbohydrate more important than the source
- No justification for the restriction of sugars
- Minimal, if any, effect from food fiber
- Nonnutritive sweeteners safe, helpful to reduce total carbohydrate intake

**Unknown**
- Role of the glycemic index
- Unprocessed versus processed food
Glucose Response to Dextrose, Rice, Corn, Potato and Bread

(Crapo. Diabetes 26 (12):1180, 1977.)
Sucrose in The Diet of Diabetic Patients - Just Another CHO?

- 12 Type 1; 11 Type 2; 6 weeks
- 54% CHO
  - 45 g complex CHO replaced for 45 g of sucrose (18% of calories)
- No differences: day-long glucose levels, glycated hemoglobin, lipids, insulin profiles in Type 2

(Peterson et al Diabetologia 1986)
Sucrose or Starch - Total Carbohydrate
Consistent

Mean Plasma Glucose (mmol/l) vs Time of Day (h)

Type 1 Diabetes
Type 2 Diabetes
Acceptable Daily Intake (ADI)

• The amount that can be safely consumed on a daily basis over a person’s lifetime without adverse effects

• Includes a 100-fold safety factor
Accepted Daily Intake (ADIs)* of Nonnutritive Sweeteners

<table>
<thead>
<tr>
<th></th>
<th>ADI (mg/kg) body weight</th>
<th>Avg. mg in 12-oz soda</th>
<th>Cans of soda to reach ADI for 60-kg (132 lb) person</th>
<th>Ag mg in packet of sweetner</th>
<th>Packets to reach ADI for 60-kg person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acesulfame K</td>
<td>15</td>
<td>40</td>
<td>25</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Aspartame</td>
<td>50</td>
<td>200</td>
<td>15</td>
<td>35</td>
<td>86</td>
</tr>
<tr>
<td>Saccharin</td>
<td>5</td>
<td>140</td>
<td>2</td>
<td>40</td>
<td>7.5</td>
</tr>
<tr>
<td>Sucralose</td>
<td>5</td>
<td>70</td>
<td>4.5</td>
<td>5</td>
<td>60</td>
</tr>
</tbody>
</table>

*ADI: 1/100th of the amount tested and shown to be safe in animals

Focus on Carbohydrate

- Useful for all persons with diabetes
- Emphasizes total amount of carbohydrate not the source
- Based on 3 food groups:
  - Carbohydrate
  - Meat and meat substitutes
  - Fat
Three Food Groups

- Carbohydrates
  - Starches
  - Fruits
  - Milk
  - Sweets
- Meat and Meat Substitutes
- Fats
Carbohydrate Counting

- Sources of carbohydrate are starches, fruits, milk, and desserts
- One carbohydrate serving = 15 grams of carbohydrate
Carbohydrate Counting Recommendations

- Start with 3 to 4 servings per meal for women, 4 to 5 for men; 1 to 2 for snacks
- Emphasize day-to-day consistency
- Test post-meal; goal blood glucose <180 mg/dL
Food Labels

- Locate serving size
- Locate total grams of carbohydrate
  - 15 g = 1 carbohydrate choice
  - Ignore sugar grams
- Locate total grams of fat
  - 3 or less g of total fat for every 15 g of carbohydrate
  - 3 or less g of total fat per 7-8 g of protein
  - 1/3 or less of total fat g from saturated fat
Medical Nutrition Therapy for Diabetes: Protein, Fat and Alcohol

Marion J. Franz, MS, RD, CDE
Minneapolis, MN
Protein

**Evidence-Based**

- Effect on blood glucose dependent on insulin availability
- With adequate insulin, minimal, if any, effect on blood glucose levels
- Requires insulin for metabolism

**Unknown**

- Why doesn’t protein affect blood glucose levels?
- Does protein prevent late-onset hypoglycemia in type 1 diabetes?
- In mild type 2 diabetes, protein stimulates more insulin than in nondiabetic, is this beneficial?
Effect of Protein on Glucose and Insulin Response in Type 2 Diabetes

• 9 type 2; 50 g protein, 50 g glucose, 50 g protein with 50 g glucose
• Glucose flat response with protein alone
• Glucose peak response similar for glucose alone or glucose with protein
• Insulin response the same for glucose or protein alone
• Insulin response greater to protein combined with glucose

(Nuttall et al. Diabetes Care 1984)
Protein and Fat Effects on Glucose Responses and Insulin Requirements in Type 1 Diabetes

• 12 type 1 on biostator; standard lunch of 450 kcal compared to protein-added (200 kcal) or fat-added (200 kcal)

• Blood glucose and insulin measured over 5 hrs

• The late (2-5 hr) glucose and insulin response was slightly greater for the protein-added but unchanged for fat-added; glucose levels the same at 5 hrs

• For the extra 50 g protein only 2-3 extra units of insulin were required

Treatment and Prevention of Subsequent Hypoglycemia: CHO Versus CHO Plus Protein

- 6 subjects with type 1 diabetes on two occasions were made hypoglycemic (50 mg/dL) and treated with bread (85 kcal) or bread plus meat (205 kcal); 15 g CHO
- Insulin infusion continued for next 3 hrs or until glucose again fell to 50 mg/dL
- Neither the post treatment peak glucose level or subsequent rate of fall of glucose differed
- Treatment with protein-enriched snack merely adds calories

(Gray et al. J Clin Endocrinol Metab 81:1508, 1996)
Fat

Evidence-Based
- Saturated fats increase risk for cardiovascular disease
- Recommendations based on lipid profile
- Either carbohydrate or monounsaturated fat can replace saturated fat

Unknown
- Dietary fat shown to inhibit glucose uptake and contribute to insulin resistance
- Are triglycerides from a high carbohydrate diet atherogenic?
- Higher in calories than carbohydrate or protein, may make weight loss more difficult
Dietary Fat and Diabetes

- Percentage of calories from fat based on:
  - Nutrition assessment
  - Primary problem and treatment goals

- Higher CHO, low-fat versus moderate CHO and higher monounsaturated fat diets
  - When calories kept at level to prevent weight loss, higher CHO diet led to increases in TG
  - With a low-calorie, low-fat diet there was no detrimental effect on lipids
Effect of Energy Restriction, Weight Loss, and Diet Composition on Lipids and Glucose in Type 2 Diabetes

- 35 obese type 2, 1 of 3 1600 kcal diets for 12 weeks: high CHO, high MUFA, or high SFA
- Energy restriction and weight loss reduced FPG, insulin, GHb, BP, independent of diet composition
- High CHO and MUFA lowered cholesterol and LDL, high SFA raised cholesterol, triglyceride levels did not change
- Energy restriction, independent of diet composition, improves BG and BP, however, both high CHO and MUFA improve CHD risk profile and can replace SFA

(Heilbronn et al., Diabetes Care 22:889, 1999)
Alcohol

Evidence-Based

• With usual food intake, BG and insulin levels are not affected by moderate amounts of alcohol
• Without food, hypoglycemia can occur
• Type of alcohol does not make a difference

Unknown

• Do moderate amounts of alcohol reduce insulin resistance, decrease risk of developing type 2 diabetes, coronary heart disease, or stroke?
Alcohol with Meal Has No Adverse Effects on Blood Glucose

- 10 type 1; 16 type 2
- Alcohol (1 g/kg; vodka before, wine with, cognac after dinner) compared to equal amounts of mineral water
- Type 1 and type 2: blood glucose and insulin levels similar identical on both days
- No hypoglycemic values after alcohol in either group

(Koivisto et al. Diabetes Care 16:1512, 1993)
Recommendations for Alcohol

- With usual food intake, blood glucose levels are not affected by moderate amounts of alcoholic beverages.

- In the fasting state, hypoglycemia can occur at blood alcohol levels which do not exceed mild intoxication.
Alcohol and Diabetes

Recommendations:

• Men: limit to 2 drinks (2 oz of alcohol) per day in addition to their meal plan

• Women: limit to 1 drink (1 oz of alcohol) per day in addition to their meal plan
Medical Nutrition Therapy for Diabetes: Prioritizing Nutrition Messages

Marion J. Franz, MS, RD, CDE
Minneapolis, MN
People with Diabetes Are Given Many Messages

- Blood glucose control, not weight loss
- Count carbohydrates
- Eat high fiber foods
- Increase physical activity
- Don’t eat sugar
- Cut back on fat
- Eat only 3 meals
- Lose weight
- Eat foods with a low glycemic index
- Keep food and blood glucose records
Prioritizing Nutrition Messages

Medical Nutrition Therapy

- Emphasize blood glucose control, not weight loss
- Focus on carbohydrate foods, portions, and number of servings per meal
- Encourage physical activity
- Use food records with blood glucose monitoring data
Medical Nutrition Therapy in Practice

Priorities for Diabetes Care

- Determine patient’s readiness and ability to make changes
- Prioritize nutrition recommendations
- Evaluate treatment outcomes
- Plan for follow-up and continuing education

*Work together as a TEAM!*