Thank you for attending

Lifestyle Modification for Prevention and Management of Diabetes Mellitus

A Live and Archived Webcast
Sponsored by Community Health Association of Mountain/Plains States (CHAMPS)
Presented by Michael T. McDermott, MD on Wednesday, April 15, 2009

Supplementary Information Packet

Contents:

- Learning Objectives
- AAFP Statement
- Biography of Michael McDermott
- Description of CHAMPS
- Presentation Slides
- Additional CHAMPS Online Resources
Learning Objectives

- Review the epidemiology of the progressive epidemic of Type 2 Diabetes Mellitus in the United States
- Explain the current concepts of the pathophysiology of Type 2 Diabetes Mellitus
- Discuss the various dietary alterations that have been shown to be valuable in the prevention and management of Type 2 Diabetes Mellitus
- Explain the role of regular physical activity in preventing and treating Type 2 Diabetes Mellitus
- Review weight loss strategies and the effects of successful weight reduction and maintenance on Type 2 Diabetes Mellitus

CHAMPS clinical programs are designed to help Region VIII Community, Migrant, and Homeless Health Centers (CHCs) improve care processes and outcomes. This event addresses HRSA Health Center Performance Measure: Health Care Plan – Health Outcomes/Disparities – Diabetes.

AAFP Statement

This live webcast has been reviewed and is acceptable for up to 1.5 Prescribed credits by the American Academy of Family Physicians (AAFP). Application for 1.5 hours of Prescribed CME credit for the archived version of this webcast will be filed immediately after the live event. Michael McDermott has indicated that he has no relationships to disclose relating to the subject matter of his presentation. The AAFP invites comments on any activity that has been approved for AAFP CME credit. Please forward your comments on the quality of this activity to cmeCompat@aafp.org.

Biography of Michael McDermott

Michael McDermott received his undergraduate degree from Georgia Institute of Technology in Atlanta, Georgia, and his medical degree from Tulane University in New Orleans, Louisiana. He completed his internship and his residency in internal medicine and his fellowship in endocrinology and metabolism at the Fitzsimons Army Medical Center in Aurora, Colorado. Dr. McDermott is currently Professor of Medicine and Clinical Pharmacy at the University of Colorado Denver Health Sciences Center. Dr. McDermott is an active member of The Endocrine Society, the American Diabetes Association, the American Society for Bone and Mineral Research, the American Thyroid Association, and the Colorado Medical Society. He currently serves on the Board of Directors for the American Thyroid Association. Dr. McDermott’s clinical research interests include the treatment of type 1 and type 2 diabetes mellitus, the treatment of osteoporosis and related metabolic bone diseases, and the pathophysiology of disorders of the thyroid gland.

Description of CHAMPS

CHAMPS, the Community Health Association of Mountain/Plains States, is a non-profit organization dedicated to supporting all Region VIII (CO, MT, ND, SD, UT, and WY) federally-funded Community, Migrant, and Homeless Health Centers (CHCs) so they can better serve their patients. Currently, CHAMPS programs and services focus on education and training, collaboration and networking, policy and funding communications, and the collection and dissemination of regional data for Region VIII CHCs and Primary Care Associations (PCAs). For more information, please visit www.champsonline.org or call (303) 861-5165.
Lifestyle Modification for Prevention and Management of Diabetes Mellitus

Presented by
Michael T. McDermott MD
Director, Endocrinology and Diabetes Program
University of Colorado Hospital
April 15, 2009
11:30 am – 1:00 pm MT

Diabetes Mellitus
23.6 Million Americans in 2008

Type 2 DM
Type 1 DM

5%
95%

Leading US Cause
Myocardial Infarction
Kidney Failure
Amputations
Blindness

~ 3,500 New Cases Every Day
~ 1,000,000 New Cases Every Year

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~ 3,500 New Cases Every Day
~ 1,000,000 New Cases Every Year

Millions of Cases of Diabetes in 2000 and Projections for 2030

Clinical Practice Recommendations: ADA 2009
Current Criteria for Diagnosis of Diabetes

Fasting plasma glucose ≥ 126 mg/dl (7 mmol/l)
- Fasting: no caloric intake for 8 hours

Symptoms of hyperglycemia and a random plasma glucose ≥ 200 mg/dl (11.1 mmol/l)
- Random: any time of day; no regard to time since last meal
- Symptoms: polydipsia, polyuria, unexplained weight loss

2 hour plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test (OGTT)
- OGTT: 75 gm anhydrous glucose dissolved in water


Clinical Practice Recommendations: ADA 2009
Current Criteria for Diagnosis of Pre-Diabetes

Impaired Fasting Glucose (IFG)
- Fasting plasma glucose: 100-125 mg/dl
- Fasting: no caloric intake for 8 hours

Impaired Glucose Tolerance (IGT)
- 2 hour plasma glucose: 140-199 mg/dl during an oral glucose tolerance test (OGTT)
- OGTT: 75 gm anhydrous glucose dissolved in water

Diabetes Care 2009; 32 (Suppl 1):S1-S98 (S6, S13-14, S62-67)

Metabolic Syndrome
Components (any 3)

- Abdominal Obesity
- Men: waist > 40 inches
- Women: waist > 35 inches
- Elevated Fasting Glucose (> 100 mg/dl)
- Hypertension (> 130/85)
- Hypertriglyceridemia (> 150 mg/dl)
- Low HDL (< 40 mg/dl)

International Diabetes Federation, April 2005

Prevalence in USA 23.7%

NANES III data

Excess Caloric Intake

Lack of Exercise
**Type 1 Diabetes Mellitus**

**Pathophysiology**

- Absolute Insulin Deficiency
- Autoimmune Beta Cell Destruction

**Type 2 Diabetes Mellitus**

**Pathophysiology**

- \( \downarrow \text{GLP-1} \rightarrow \downarrow \text{Insulin} \rightarrow \uparrow \text{Glucagon} \rightarrow \downarrow \text{Glucose Utilization} \rightarrow \text{Hyperglycemia} \)
- \( \uparrow \text{Glucose Production} \rightarrow \downarrow \text{Glucose Utilization} \)

**Type 1 Diabetes Mellitus**

**Treatment**

**Physiologic Insulin Therapy**

- Absolute Insulin Deficiency
- Autoimmune Beta Cell Destruction

**Type 2 Diabetes Mellitus**

**Prevention**

- **Lifestyle Modification**
  - Diet
  - Exercise
  - Weight Loss

**Diabetes Prevention Program**

**Study Design**

- 3234 Nondiabetic Subjects with IFG +/or IGT
- Mean age: 51 yr  Mean BMI: 34 kg/m²  (68% W, 34% M)
- RCT: Lifestyle Modification vs Metformin vs Control

**Lifestyle Modification Goals**

- 7% Weight Loss
- 150 min/week Physical Activity
The incidence of diabetes in persons at high risk was reduced by:
- Lifestyle changes (58%)
- Metformin (31%)
- The lifestyle intervention was more effective than metformin.
Finnish Diabetes Prevention Study


Type 2 DM Prevention

Dietary Patterns – Whitehall II Study

7,339 Subjects aged 35-55 years

Foods Associated with High Risk of DM
- Sweetened beverages
- Diet soft drinks
- Burgers
- Sausages
- Onions
- Crisps / Snacks
- White Bread

Foods Associated with Low Risk of DM
- High fiber cereal
- French dressing
- Vinaigrette
- Jam
- Whole grain bread

McNaughton S, Diabetes Care 2008; 31:1343

Diabetes Prevention Trials

Lifestyle Modification

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Subjects</th>
<th>Age (Yrs)</th>
<th>Intervention (Daily Dose)</th>
<th>Conversion In Controls (%/yr)</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finnish DPS</td>
<td>522</td>
<td>IGT BMI ≥ 25</td>
<td>55</td>
<td>3.2 Individual Diet/Exercise</td>
<td>6</td>
<td>0.42 (0.39-0.70)</td>
</tr>
<tr>
<td>DPP</td>
<td>2161</td>
<td>IGT BMI ≥ 24 FPG &gt; 95</td>
<td>51</td>
<td>3 Individual Diet/Exercise</td>
<td>10</td>
<td>0.42 (0.34-0.52)</td>
</tr>
<tr>
<td>Da Qing</td>
<td>259</td>
<td>IGT</td>
<td>45</td>
<td>6 Group Diet/Exercise</td>
<td>16</td>
<td>0.62 (0.44-0.86)</td>
</tr>
<tr>
<td>Toranomon</td>
<td>458</td>
<td>IGT BMI = 24 5 Men</td>
<td>55</td>
<td>4 Individual Diet/Exercise</td>
<td>2</td>
<td>0.33 (0.19-1.0)</td>
</tr>
<tr>
<td>Indian DPP</td>
<td>269</td>
<td>IGT</td>
<td>46</td>
<td>2.5 Individual Diet/Exercise</td>
<td>22</td>
<td>0.71 (0.63-0.79)</td>
</tr>
</tbody>
</table>

Pan XR, Diabetes Care 1997; 20:537-44

Jeon C, Diabetes Care 2007; 30:744

Type 2 DM Prevention

Fruit and Vegetable Intake

71,346 Female Nurses (healthy), Age: 38-63
Diet information collected every 4 years
Followed for 18 years: Diabetes – self reported

<table>
<thead>
<tr>
<th>Foods</th>
<th>HR for DM</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake of whole</td>
<td>18%</td>
<td>6-28%</td>
</tr>
<tr>
<td>Fruit by 3 servings/d</td>
<td>9%</td>
<td>2-16%</td>
</tr>
<tr>
<td>Intake of green leafy Vegetables by 1 serving/d</td>
<td>18%</td>
<td>10-26%</td>
</tr>
</tbody>
</table>

Bazzano L, Diabetes Care 2008; 31:1311

Type 2 DM Prevention

Physical Activity of Moderate Intensity

Review
10 Cohort Studies
301,221 Subjects
9367 DM Cases

Regular Exercise
RR of DM2
31% (CI:17-42%)

Regular Walking
RR of DM2
38% (CI:16-42%)

Bazzano L, Diabetes Care 2008; 31:1311
Type 2 DM Prevention
Diet and Lifestyle Risk Factors
84,951 Female Nurses followed from 1980-1996

**High Risk for DM**
- BMI ≥ 25 kg/m²
- Lack of exercise
- Diet: ↓ fiber
- ↑ trans fat
- ↓ polyunsaturated fat
- ↑ glycemic load
- Current smoking
- Abstinence from EthOH

**Low Risk for DM**
- BMI < 25 kg/m²
- Regular exercise
- Diet: ↑ fiber
- ↓ trans fat
- ↑ polyunsaturated fat
- ↓ glycemic load
- No smoking
- EthOH ≥ ½ serving/day


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Type 2 DM Prevention
Lifestyle Education
Review of 8 Qualifying Studies

**Lifestyle Education (vs Control)**
- 2 Hr PPBG ↓ 15 mg/dl
- 1 Yr Incidence DM ↓ 50%

Yamaoka K, Diabetes Care 2005; 28:2786

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**Summary of Type 2 Diabetes Prevention**
- Type 2 Diabetes can be prevented
- Lifestyle modification with diet, exercise and weight loss are more effective than medications in preventing the development of Type 2 Diabetes
- Dietary measures associated with the lowest risk of developing Type 2 Diabetes are high intake of fiber, fruits, and vegetables, and low intake of saturated fat, trans-fat and fruit juices
- Regular exercise independently reduces the risk of developing Type 2 Diabetes
- Weight loss significantly reduces the risk of developing Type 2 Diabetes

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**Diabetes Prevention Trials**

<table>
<thead>
<tr>
<th>Study</th>
<th>N Subjects</th>
<th>Age (Yrs)</th>
<th>Intervention (Daily Dose)</th>
<th>Conversion In Controls (%/yr)</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPP</td>
<td>2155</td>
<td>51</td>
<td>Metformin 1500 mg</td>
<td>10</td>
<td>0.69 (0.57-0.83)</td>
</tr>
<tr>
<td>Indian DPP</td>
<td>269</td>
<td>46</td>
<td>Metformin 500 mg</td>
<td>22</td>
<td>0.74 (0.65-0.81)</td>
</tr>
<tr>
<td>Stop NIDDM</td>
<td>1419</td>
<td>54</td>
<td>Acarbose 300 mg</td>
<td>13</td>
<td>0.75 (0.63-0.90)</td>
</tr>
<tr>
<td>XENDOS</td>
<td>3277</td>
<td>43</td>
<td>Orlistat 360 mg</td>
<td>2</td>
<td>0.65 (0.46-0.86)</td>
</tr>
<tr>
<td>DREAM</td>
<td>5269</td>
<td>55</td>
<td>Rosiglitazone 8 mg</td>
<td>9</td>
<td>0.40 (0.35-0.46)</td>
</tr>
</tbody>
</table>

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**Type 2 Diabetes Mellitus**

**Treatment**
- **Lifestyle Modification**
  - Diet
  - Exercise
  - Weight Loss
- **Medications**

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Ramachandran A, Diabetes Care 2006; 29:1209-17
Gerstein HC, Lancet 2006; 368:1096-1105
Chaisson JL, Lancet 2002; 359:272-31

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Targerson JS, Diabetes Care 2006; 29:155-61
Mann JF, Diabetes Care 2004; 27:155-61
Sengupta S, JAMA 2002; 288:592-97
Gurinov IE, Lancet 2006; 368:1096-1105
Chaisson JL, Lancet 2002; 359:272-31
Type 2 DM Treatment
Low Carbohydrate Diet
10 Subjects with Obesity and Type 2 DM
Usual Diet (UD) for 7 days, followed by
Low Carb Diet (LCD) for 14 days [21 g Carb; 84 kcal]

<table>
<thead>
<tr>
<th>LCD vs UD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorie Intake ↓ 947 kcal/d</td>
<td>.001</td>
</tr>
<tr>
<td>Body Weight ↓ 2.02 kg</td>
<td>.042</td>
</tr>
<tr>
<td>Fat Mass ↓ 2.45 kg</td>
<td>.026</td>
</tr>
</tbody>
</table>

LCD vs UD
P-value
FPG ↓ 22 mg/dl | .025
A1C ↓ 0.5% | .006
Insulin ↓ | .039
Triglycerides ↓ 35% < .001
Cholesterol ↓ 10% | .02


Type 2 DM Treatment
Low Carbohydrate Diet
Calorie Intake ↓ 947 kcal/d p = .001
Body Weight ↓ 2.02 kg p = .042


Type 2 DM Treatment
Low Carbohydrate Diet
Fasting Plasma Glucose ↓ 22 mg/dl p = .025
Plasma Insulin ↓ p = .039

Garg, JAMA 1994; 271:1421-8

Type 2 DM Treatment
Varying Carbohydrate Content
42 Subjects with Type 2 DM (33 M, 9 W)
High Carbohydrate vs High Monounsaturated Fat Diet
Cross-over Study: All patients on each diet for 6 weeks

<table>
<thead>
<tr>
<th>Energy Intake per Day (%)</th>
<th>High COOH</th>
<th>High MUS Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>Sucrose</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fat</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Monounsaturated</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Polyunsaturated</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Saturated</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Protein</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

High Protein vs Control Diet
P-Value
A1C: ↓ 0.5% < .05
24 Hour Glucose: ↓ 40% < .02

Gannon MC, Am J Clin Nutr 2003;78:734-41

Type 2 DM Treatment
Varying Carbohydrate Content
42 Subjects with Type 2 DM (33 M, 9 W)
High Carbohydrate vs High Monounsaturated Fat Diet
Cross-over Study: All patients on each diet for 6 weeks

<table>
<thead>
<tr>
<th>Daylong</th>
<th>High COOH vs High MUS Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>↑ 12% p &lt; .001</td>
</tr>
<tr>
<td>Insulin</td>
<td>↑ 9% p = .02</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>↑ 10% p = .03</td>
</tr>
</tbody>
</table>

Garg, JAMA 1994; 271:1421-8
Crossover Study: 13 Subjects with Type 2 DM on 2 Diets
High Fiber (HF): 50 g (25 g soluble; 25 g insoluble)
Moderate Fiber (MF): 24 g (8 g soluble; 16 g insoluble)

<table>
<thead>
<tr>
<th></th>
<th>HF vs MF</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprandial BG ↓ 13 mg/dl</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>24 Hour BG ↓ 10%</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>24 Hour Insulin ↓ 12%</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

LDL vs UD

<table>
<thead>
<tr>
<th></th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol ↓ 6.7%</td>
<td>.02</td>
</tr>
<tr>
<td>Triglyceride ↓ 10.2%</td>
<td>.02</td>
</tr>
<tr>
<td>VLDL Cholesterol ↓ 12.5%</td>
<td>.01</td>
</tr>
</tbody>
</table>

Type 2 DM Treatment
High Fiber Diet

251 Subjects with Type 2 DM (Age: 39-70)
Aerobic, Resistance, or Combined Training 3x/wk for 22 weeks

<table>
<thead>
<tr>
<th>Exercise Comparison</th>
<th>A1C</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic v Control</td>
<td>↓ .51</td>
<td>.007</td>
</tr>
<tr>
<td>Resistance v Control</td>
<td>↓ .38</td>
<td>.038</td>
</tr>
<tr>
<td>Combined v Aerobic</td>
<td>↓ .46</td>
<td>.014</td>
</tr>
<tr>
<td>Combined v Resistance</td>
<td>↓ .59</td>
<td>.001</td>
</tr>
</tbody>
</table>

Misra A, Diabetes Care 2008; 31:1282

62 Latino Adults with Type 2 DM (40 M, 22 W; age 66 +/- 8 yr)
Progressive resistance training (PRT) vs Control for 16 weeks

<table>
<thead>
<tr>
<th>Group</th>
<th>Change (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRT</td>
<td>A1C ↓ 1.1%</td>
<td>No Δ</td>
</tr>
<tr>
<td>DM Meds</td>
<td>↓ 72%</td>
<td>↓ 42%</td>
</tr>
</tbody>
</table>

Castañeda C, Diabetes Care 2002; 25:2335
Type 2 DM Treatment

**Look Ahead Study**

5145 Subjects with Type 2 DM and BMI > 25

**Characteristics Associated with Lower BMI**
- Self Weighing
- Breakfast Consumption
- Infrequent Fast Food

Raynor H, Diabetes Care 2008; 31:1299

Type 2 DM Treatment

**Weight Loss Strategies**

RCT: 48 Overweight/Obese Subjects with Type 2 DM
Combination Weight Loss (C) vs Standard (S) Therapy for 1 year
Followed by Combination (S/C) in the 2nd year

**Combination (C) Therapy**
- Diet: 500-1000 kcal/day deficit
- Exercise: walk 30 min/day ≥ 3/week
- Sibutramine or
- Provided low calorie diet (900-1300 kcal/d)

**Standard (S) Therapy**
- Diet: 500-1000 kcal/day deficit
- Exercise: walk 30 min/day ≥ 3/week

Redmon JB, Diabetes Care 2005; 28:1311

Type 2 DM Treatment

**Weight Loss Strategies – ICAN Study**

RCT: 147 Subjects with Type 2 DM and Obesity
Lifestyle Care Management (CM) vs Usual Care (UC)

**CM vs UC**
- Weight -3.0 Kg
  (CI: -5.4 to -0.6)
- Waist -4.1 cm

Wolf AM, Diabetes Care 2004; 27:1570

Type 2 DM Treatment

**Weight Loss Strategies – ICAN Study**

RCT: 147 Subjects with Type 2 DM and Obesity
Lifestyle Care Management (CM) vs Usual Care (UC)

**A1C**
- A. Initial A1C < 7.45%
  p = 0.7 at 12 months
- B. Initial A1C > 7.45%
  p = 0.9 at 12 months

**CM vs UC**
- Fewer Meds

Wolf AM, Diabetes Care 2004; 27:1570
**Type 2 DM Treatment**

Weight Loss Strategies – ICAN Study

RCT: 147 Subjects with Type 2 DM and Obesity - HRQOL Lifestyle Care Management (CM) vs Usual Care (UC)

All Measures Favored CM

**Summary of Type 2 Diabetes Treatment**

- Type 2 Diabetes should be treated with lifestyle intervention and, in most cases, with medications
- Dietary measures that are most effective for treating Type 2 Diabetes are high intake of fiber, modest reduction of carbohydrates and a modest increase in protein intake
- Aerobic and resistance exercise both improve glycemic control in patients with Type 2 Diabetes
- Weight loss significantly improves glucose control in patients with Type 2 Diabetes

**Algorithm for Type 2 Diabetes**

Tier 1: well-validated core therapies

- Lifestyle + Metformin + Basal Insulin
- Lifestyle + Metformin + Sulfonylurea

Tier 2: less well-validated core therapies

- Lifestyle + Metformin + Pioglitazone + GLP-1 agonist

Tier 3: intensive insulin

- Lifestyle + Metformin + Intensive insulin

**Type 2 Diabetes Mellitus**

Pathophysiology Based Treatment

- Sulfonylurea: Meglitinide
- GLP-1: Exenatide
- DPP4 Inhibitor

**Glucose Utilization**

- Insulin
- Glucagon
- Thiazolidinedione

**Glucose Production**

- Metformin
- Thiazolidinedione

**Glucose Production**

- Metformin
- Thiazolidinedione

**Glucose Utilization**

- Metformin
- Thiazolidinedione

**Algorithm for Type 2 Diabetes**

Tier 1: well-validated core therapies

- Lifestyle + Metformin + Basal Insulin
- Lifestyle + Metformin + Sulfonylurea

Tier 2: less well-validated core therapies

- Lifestyle + Metformin + Pioglitazone + GLP-1 agonist

Tier 3: intensive insulin

- Lifestyle + Metformin + Intensive insulin

**Type 2 Diabetes Mellitus**

Lifestyle Intervention + Metformin

- 3 Months: A1C ≥ 7.8

- Basal Insulin
- Basal Bolus Insulin
- Basal Bolus Insulin

**Algorithm for Type 2 Diabetes**

Tier 1: well-validated core therapies

- Lifestyle + Metformin + Basal Insulin
- Lifestyle + Metformin + Sulfonylurea

Tier 2: less well-validated core therapies

- Lifestyle + Metformin + Pioglitazone + GLP-1 agonist

Tier 3: intensive insulin

- Lifestyle + Metformin + Intensive insulin

**Obesity is the Primary Risk Factor for Type 2 Diabetes**

Age-adjusted relative risk of type 2 diabetes

Men: 1, 2.2, 12, 42, 100

Women: 1, 2.2, 8.5, 40, 93

BMI: 0, 1.0, 25, 31, ≤35

Assessment of Obesity

Body Mass Index

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Weight Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25</td>
<td>Normal</td>
</tr>
<tr>
<td>25-30</td>
<td>Overweight</td>
</tr>
<tr>
<td>30-35</td>
<td>Obese, class 1</td>
</tr>
<tr>
<td>35-40</td>
<td>Obese, class 2</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>Obese, class 3</td>
</tr>
</tbody>
</table>

Genetic or Acquired Disorder?

Positive Energy Balance

Energy In > Energy Out

Energy Intake

Energy Expenditure

Dr. Michael McDermott. 04/15/09
Weight Gain
Positive Energy Balance

1 lb. = 3,500 kcal

<table>
<thead>
<tr>
<th>Excess/day</th>
<th>Wt. Gain (1 yr)</th>
<th>Wt. Gain (20 yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 kcal</td>
<td>1 lb</td>
<td>20 lb</td>
</tr>
<tr>
<td>50 kcal</td>
<td>5 lb</td>
<td>100 lb</td>
</tr>
<tr>
<td>100 kcal</td>
<td>10 lb</td>
<td>200 lb</td>
</tr>
</tbody>
</table>

Negative Energy Balance
Energy In < Energy Out

Weight Loss
Negative Energy Balance

1 lb. = 3,500 kcal

<table>
<thead>
<tr>
<th>Deficit/day</th>
<th>Loss/4 wks</th>
<th>Loss/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kcal</td>
<td>2 lb</td>
<td>26 lb</td>
</tr>
<tr>
<td>500 kcal</td>
<td>4 lb</td>
<td>52 lb</td>
</tr>
<tr>
<td>1000 kcal</td>
<td>8 lb</td>
<td>104 lb</td>
</tr>
</tbody>
</table>

Obesity
Treatment Options

- Diet (energy restriction)
- Exercise (energy utilization)
- Medications (energy restriction)
- Surgery (energy restriction)

Treatment of Obesity
Diet - Calorie Restriction

- Portion control
- Avoid snacks
- Avoid desserts
- Avoid fast food
- Count calories

1 gm carbohydrate 4 kcal
1 gm protein 4 kcal
1 gm fat 9 kcal
Weight Loss
Negative Energy Balance

1 lb. = 3,500 kcal

<table>
<thead>
<tr>
<th>Deficit/day</th>
<th>Per Meal</th>
<th>Loss/4 wks</th>
<th>Loss/year*</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kcal</td>
<td>83 kcal</td>
<td>2 lb</td>
<td>26 lb</td>
</tr>
<tr>
<td>500 kcal</td>
<td>167 kcal</td>
<td>4 lb</td>
<td>52 lb</td>
</tr>
<tr>
<td>1000 kcal</td>
<td>333 kcal</td>
<td>8 lb</td>
<td>104 lb</td>
</tr>
</tbody>
</table>

*If no change in exercise or RMR

Traditional Diet
Macronutrient Composition

- Carbohydrate: 50-55% of calories
- Protein: 15-20% of calories
- Fat: 25-30% of calories

Recommended by American Heart Association

A Randomized Trial of a Low-Carbohydrate Diet for Obesity

63 Obese Subjects (BMI 34) [43 W, 20 M; age 44]
Low Carbohydrate, High Fat, High Protein Diet vs Low Fat, High Carbohydrate, Low Calorie Diet
Duration: 12 months  No Diabetic Subjects

Low Carbohydrate, High Fat, High Protein Diet (LC):
20 g carbohydrate (80 kcal) – Atkins Diet
Low Fat, High Carbohydrate, Low Calorie Diet (LF):
25% Fat, 60% Carbohydrate, 15% Protein
Women: 1200-1500 kcal/day; Men: 1500-1800 kcal/day

A Low-Carbohydrate as Compared with a Low-Fat Diet in Severe Obesity

132 Morbidly Obese Subjects (BMI 43) [24 W, 108 M; age 53]
Low Carbohydrate, High Fat Diet vs Low Fat, High Carbohydrate Diet
Duration: 12 months  53 (40%) Diabetic Subjects

Low Carbohydrate, High Fat Diet (LC):
37% Carbohydrate
41% Fat
22% Protein

Low Fat, High Carbohydrate Diet (LF):
51% Carbohydrate
33% Fat
16% Protein
A Low-Carbohydrate as Compared with a Low-Fat Diet in Severe Obesity

**Body Weight**

<table>
<thead>
<tr>
<th>Time</th>
<th>Body Weight Loss</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mos.</td>
<td></td>
<td>.002</td>
</tr>
<tr>
<td>4 mos.</td>
<td></td>
<td>.001</td>
</tr>
<tr>
<td>6 mos.</td>
<td></td>
<td>.002</td>
</tr>
</tbody>
</table>


A Low-Carbohydrate as Compared with a Low-Fat Diet in Severe Obesity

**Body Weight**

<table>
<thead>
<tr>
<th>Time</th>
<th>Body Weight Loss</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mos.</td>
<td></td>
<td>.002</td>
</tr>
<tr>
<td>12 mos.</td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>


**Table:**

<table>
<thead>
<tr>
<th>Group</th>
<th>FBG 6 mos</th>
<th>A1C 6 mos</th>
<th>A1C 6 mos</th>
<th>Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Carbohydrate, High Fat Diet (LF)</td>
<td>12.1 mg/dl</td>
<td>0.5%</td>
<td>4.0 mU</td>
<td></td>
</tr>
<tr>
<td>Low Carbohydrate, Mediterranean Diet (LCM)</td>
<td>9.8 mg/dl</td>
<td>0.4%</td>
<td>2.2 mU</td>
<td></td>
</tr>
<tr>
<td>Diabetics (LC)</td>
<td>L - 9%</td>
<td>L - 0.6%</td>
<td>L - 8%</td>
<td></td>
</tr>
<tr>
<td>Diabetics (LF)</td>
<td>L - 17%</td>
<td>L - 13%</td>
<td>L - 1%</td>
<td></td>
</tr>
</tbody>
</table>


**Diabetes Table:**

<table>
<thead>
<tr>
<th>Group</th>
<th>FBG 6 mos</th>
<th>A1C 6 mos</th>
<th>A1C 6 mos</th>
<th>Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Carbohydrate, Unrestricted Calorie Diet (LC)</td>
<td>12.1 mg/dl</td>
<td>0.5%</td>
<td>4.0 mU</td>
<td></td>
</tr>
<tr>
<td>Low Carbohydrate, Mediterranean Diet (LCM)</td>
<td>9.8 mg/dl</td>
<td>0.4%</td>
<td>2.2 mU</td>
<td></td>
</tr>
<tr>
<td>Low Fat, Low Calorie Diet (LF) – based on Atkins diet</td>
<td>9.8 mg/dl</td>
<td>0.4%</td>
<td>2.0 mU</td>
<td></td>
</tr>
</tbody>
</table>


**Weight Loss with a Low-Carbohydrate, Mediterranean, or Low-Fat Diet**

**Table:**

<table>
<thead>
<tr>
<th>Diet Type</th>
<th>Body Weight Loss</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Carbohydrate, Unrestricted Calorie Diet (LC)</td>
<td>-2.9 kg</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Low Carbohydrate, Mediterranean Diet (LCM)</td>
<td>-4.4 kg</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Low Fat, Low Calorie Diet (LF)</td>
<td>-4.7 kg</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Treatment of Obesity

Exercise
- Energy expended during exercise
- Resting metabolic rate enhanced

<table>
<thead>
<tr>
<th>Activity</th>
<th>30 Min/day</th>
<th>60 Min/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking, 3 MPH</td>
<td>130 kcal (14 lb/yr*)</td>
<td>260 kcal (28 lb/yr*)</td>
</tr>
<tr>
<td>Bicycling, 9 MPH</td>
<td>210 kcal (22 lb/yr*)</td>
<td>420 kcal (44 lb/yr*)</td>
</tr>
<tr>
<td>Running</td>
<td>320 kcal (33 lb/yr*)</td>
<td>640 kcal (66 lb/yr*)</td>
</tr>
<tr>
<td>Swimming</td>
<td>340 kcal (35 lb/yr*)</td>
<td>680 kcal (70 lb/yr*)</td>
</tr>
</tbody>
</table>

*If no change in food or RMR

Treatment of Obesity

Medications – FDA Approved
- Sibutramine: suppresses appetite
  - 5 mg, 10 mg, or 15 mg qd
- Phentermine: suppresses appetite
  - 15 mg or 30 mg qd
- Orlistat: inhibits fat absorption
  - 120 mg TID with meals

Indications:
BMI > 30 kg/m²
BMI > 25 kg/m² with obesity related disease

Bariatric Surgery

Gastric restriction
Gastroplasty
Intestinal bypass
Combination

Indications:
BMI > 40 kg/m²
BMI > 35 kg/m² with obesity related disease

Bariatric Surgery

Weight Loss – 10 Years

Control
Banding 14%
Vertical Banded Gastroplasty 16%
Gastric Bypass 25%


Mortality – 15 Years

Hazard Ratio (Adjusted)
0.71 (p=.01) ↓ 29%


Bariatric Surgery

Mortality rate: < 1%
Adverse events: ~ 20%
Beneficial effects on:
- Diabetes mellitus
- Hypertension
- Hyperlipidemia
- Sleep apnea
- Mortality

Buchwald, JAMA 2004; 292:1724
Maggard, Ann Intern Med 2005; 142:547
DeMaria E, NEJM 2007; 356:2176
Sjostrom L, NEJM 2007; 357:741
Summary of Obesity Treatment

- Obesity is the single greatest risk factor for the development of Type 2 Diabetes Mellitus
- Obesity and Diabetes are both increasing in epidemic proportions in the United States
- Negative calorie balance is necessary to lose weight
- A 500 kcal/day deficit causes significant weight loss
- Weight loss is best accomplished by a combination of calorie restriction and increased exercise
- No diet is clearly superior to any other for long term weight loss, but low carbohydrate diets have been shown to produce better short term weight loss and metabolic improvement

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www.champsonline.org/Tools/ClinicalResources/PatientEducationTools/PatientSelfMgmtDocs/DiaGoalSpan.doc

Goal Contract – English only

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Spanish
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