Lifestyle Approaches to Prevention and Management of Type 2 Diabetes

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Goal of Presentation

• Discuss how successful are we in preventing and managing type 2 diabetes with lifestyle
Progression of Chronic Disease

Metabolic Syndrome

Lean → Obesity → Diabtes → Cardiovascular Disease

- Pulmonary
- GI
- Dermatological
- Orthopedic
- Genitourinary
- Psychological
- Asthma

- Renal Disease
- Cancer
- Cognitive Impairment

Pre Diabetes
Diabetes Prevention Program (DPP)

- Intensive Lifestyle
- Metformin
- Placebo (Usual Care)
### Diabetes Prevention Program
#### Achievement of Study Goals

**Average follow-up of 2.8 years**

<table>
<thead>
<tr>
<th>Lifestyle Modifications</th>
<th>Goal</th>
<th>% Achieving Goal</th>
<th>% Achieving Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss</td>
<td>≥ 7%</td>
<td>50%</td>
<td>38%</td>
</tr>
<tr>
<td>Physical activity (min/week)</td>
<td>≥ 150</td>
<td>74%</td>
<td>58%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pharmacological Intervention</th>
<th>Placebo</th>
<th>Metformin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>≥ 80%</td>
<td>77%</td>
</tr>
<tr>
<td>Full dose</td>
<td>2 tablets/day</td>
<td>97%</td>
</tr>
</tbody>
</table>

A

Change in Weight (kg)

Placebo
Metformin
Lifestyle

Year

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

B

Change in Physical Activity (MET-hr/wk)

Lifestyle
Metformin
Placebo

Year

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Diabetes Prevention Program (DPP)
DPP Follow-Up

The graph illustrates the change in weight over the years for different interventions: Lifestyle, Metformin, and Placebo. The x-axis represents the year, and the y-axis shows the change in weight (kg). The graph shows that the Lifestyle group had a significant decrease in weight initially, followed by a slight increase, while the Metformin group maintained a steady decrease. The Placebo group showed little change over the years.
Action for Health in Diabetes (Look AHEAD)

- Lifestyle
- Diabetes Support & Education (DSE)
<table>
<thead>
<tr>
<th>Frequency of on-site visits</th>
<th>Format of treatment sessions</th>
<th>Weight loss goal</th>
<th>Activity goal</th>
<th>Special features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months 1 to 6</td>
<td>Weekly</td>
<td>Lose 10% of initial weight</td>
<td>Exercise 175 min/wk by month 6</td>
<td>Treatment toolbox</td>
</tr>
<tr>
<td>Months 7 to 12</td>
<td>3 per month</td>
<td>Continued loss or weight maintenance</td>
<td>Increase minutes per week of activity; 10,000 steps/d goal</td>
<td>Advanced toolbox options; orlistat</td>
</tr>
<tr>
<td><strong>Phase II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years 2 to 4</td>
<td>Minimum of 1 per month</td>
<td>Weight maintenance, reverse weight gain as it occurs</td>
<td>Maintain high levels of physical activity</td>
<td>Refresher groups to reverse weight gain; national campaigns across 16 centers</td>
</tr>
<tr>
<td><strong>Phase III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 5+</td>
<td>Monthly recommended</td>
<td>Prevention of weight gain</td>
<td>Prevention of inactivity</td>
<td>Refresher groups; campaigns; open</td>
</tr>
</tbody>
</table>
Percent Weight Change from Baseline

Repeated Measures Adjusted for Clinic and Baseline Level

P-value for average effect across all visits: p<0.0001
Percent Fitness Change from Baseline

Graph showing the percent fitness change from baseline over four years, with two lines representing DSE and ILI. The y-axis represents the percent change from baseline, ranging from -10 to 30. The x-axis represents the years, from 0 to 4. The DSE line starts at 0 and remains relatively flat, while the ILI line starts at 0 and increases to around 20 by year 1, then decreases to around 10 by year 4.
HbA1c Change from Baseline

-0.8
-0.7
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0
0 1 2 3 4
Year
DSE
ILI

Diabetes & Digestive & Kidney Diseases of the National Institutes of Health

Look AHEAD
Action for Health in Diabetes
HDL Cholesterol (mg/dl) Change from Baseline

![Graph showing HDL Cholesterol change from baseline over years for DSE and ILI](image-url)
Triglyceride (mg/dl) Change from Baseline

Year

0 1 2 3 4

DSE
ILI

Trig change from baseline (mg/dl)
LDL Cholesterol (mg/dl) Change from Baseline

![Graph showing LDL cholesterol change from baseline over years for DSE and ILI]
We could be very effective in preventing and managing type 2 diabetes with lifestyle IF

- we could maintain weight loss
- we could maintain permanent increases in physical activity
Good News, Bad News

• Good news
  - Doesn’t take all that much change

• Bad news
  - Hard to maintain even small reductions in weight or increases in physical activity
Comparison of weight loss diets with different compositions of fat, protein and carbohydrates (n=811)

Sacks FS. et al. *NEJM* 2009;360(9) 859-873.
% of Lost Weight Regained

Years after Weight Loss

Predicted absolute mean change in body weight for participants in the low-fat and low-carbohydrate diet groups, based on a random-effects linear model. Error bars represent 95% CIs.

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Predicted absolute mean change in serum triglyceride, VLDL cholesterol, LDL cholesterol, and HDL cholesterol concentrations in the low-fat and low-carbohydrate diet groups, based on a random-effects linear model. Error bars represent 95% CIs. To convert triglycerides to mmol/L, multiply by 0.0113.

Weight Management Paradigm Evolution

- **Acute Weight Loss**: Strategy
- **Chronic Weight Loss**: Strategy
- **Weight Loss**: Strategy 1
- **Weight Maintenance**: Strategy 2

4-6 months

Years/Forever?
Why maintaining weight loss is hard: the energy gap

220 pounds
2350 kcal/day EE

180 pounds
2350 kcal/day EE

“Energy Gap”
= 320 kcal/d

Increased
Physical
Activity

Eating
Less

180 pounds
2030 kcal/day EE
Are Diet and Physical Activity Equally Modifiable?
National Weight Control Registry (NWCR)

1. Low fat, low calorie diet
2. Lots of physical activity
3. Little TV watching
4. Breakfast
5. Self monitoring
6. Consistency
7. Dietary restraint
Relative risks of death from any cause among participants with various risk factors (e.g., history of hypertension, chronic obstructive pulmonary disease [COPD], diabetes, smoking, elevated body mass index [BMI \( \geq 30 \)] and high total cholesterol level [TC \( \geq 5.70 \text{ mmol/L} \)] who achieved an exercise capacity of less than 5 METs (metabolic equivalents) or 5-8 METs, as compared with participants whose exercise capacity was more than 8 METs.
Americans are becoming more and more inactive.

Source: Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System.
Is the Real Problem Sedentariness?
Olsen et al. JAMA 2008;299:1261-1263

- 8 Men asked to reduce daily steps – don’t take stairs, etc. for 3 weeks; 6203 to 1394 steps/day
- Insulin resistance within 1 week
- Triglycerides increased
- 7% increase in intraabdominal fat
- Decrease in fat-free mass
Permanent Changes in Lifestyle

• Behavior
  – Diet
  – Physical activity
• Environment – Physical & Social
• Culture
What is the real problem?

• We know what the behaviors are that are compatible with healthy weight…but, we don’t know how to achieve and sustain those behaviors in our modern society

• We built the paradigm we live in to serve the biology while delivering core social benefits…to change the outcome we will have to deal with both
• We are entering territory where “evidence based” approaches are not practical

  “Natural experiments” are becoming the new way to build evidence
Proposed Policies (mostly aimed at food)

- Tax the “bad” food
- “Stoplight” labeling
- Menu labeling
- Zoning restrictions for fast food
- Advertising restrictions—where, when, audience
- Modify “choice architecture”
Where are the inactivity focused policies?

- Tax sedentary technology
- Tax sedentary entertainments
- Restrict roadway usage (e.g., even and odd days)
- Use charge for elevator/escalator service under 4 floors
- Ban drive through windows
- Zoning restrictions for parking within a minimum distance of buildings
Greatest Challenges

• Biology
  – The behavioral tendencies we are fighting are hard wired into our genes

• Culture and society
  – Food and rest are rewards deeply engrained in our culture
  – Obesity has traditionally been a “personal” issue, not a public one
  – Are we prepared to make the investment in the environmental changes needed to “force” behavior change?
  – Can we find a fair way to hold people accountable for their behavior without punishing them for their genes?
Food is too cheap, physical activity is not necessary and we are too rich

• We could reduce all calorie intake by making it more costly, but that would have a regressive effect on the poor

• We could increase physical activity by restricting automobile usage, but that would have a tremendous effect on the economy

• But…as long as people have money to spend they can buy what they want, albeit less conveniently
What is missing?

• A better reason for people and society to exert cognitive control over food and physical activity behaviors…a better WHY?
• What is in it for me and what is in it for us?
• And, in terms that make the imperative essential in everyday life
  – E.g., if jobs, global competitiveness and our economy depended on changing our priorities would that catalyze real change?
• Given all the “escape routes” for people to not change we need to hold individuals and society accountable for changing
Where do we go from here?
The evidence suggests that we can prevent and manage type 2 diabetes very effectively if we can produce and sustain lifestyle changes.

This will not happen solely in the clinic.