Food Addictions, Diabetes, and Alzheimer’s Disease

Breaking the Food Seduction

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George Washington University School of Medicine
Physicians Committee for Responsible Medicine
Inside the Cell

Glucose

Insulin

Intramyocellular lipid
Plant-Based Diet for Type 2 Diabetes

Low-fat low-GI vegan diet vs ADA guidelines

22-week study, 1-year follow-up

n = 99


Funding: NIDDK; Diabetes Action Research and Education Foundation
Hemoglobin A1c at Baseline and at 11 and 22 Weeks

(n = 49 vegan, 50 ADA)

Week 0 | Week 11 | Week 22
--- | --- | ---
Vegan | ADA |
6.5 | 7.0 | 7.5 | 8.0 | 8.5

P = .089
Hemoglobin A1c at Baseline and at 11 and 22 Weeks

Individuals with no medication changes, n = 24 vegan, 33 ADA

P = 0.01
Hemoglobin A1c, All Participants
(n = 49 vegan, 50 ADA)

Data shown are last values before any change to hypoglycemic medications carried forward. For between-group comparison of changes from baseline to final values, \( P = 0.03 \).
Dopamine

Responsible for feelings of pleasure or reward.
The DRD2 Taq1 Allele

The A1 allele is associated with a reduction in dopamine receptors.

DRD2 Genotypes

A1A1, A1A2 (A1+)  A2A2 (A1-)

DRD2 Genotypes

A1A1, A1A2 (A1+)  A2A2 (A1 -)

12 - 40% of U.S. adults  60 – 88% of U.S. adults
Fewer dopamine receptors  Normal number of receptors
Higher risk of:
  Smoking
  Alcohol or drug abuse
  Compulsive gambling
  Compulsive overeating

DRD2 Substudy

Is the presence of the DRD2 A1 allele associated with poorer response to therapeutic diets?
DRD2 A1 Genotype Prevalences

A1+ : 49% (10% A1A1, 39% A1A2)

A1- : 51% (A2A2)
### Diet and Body Weight by Genotype, Black Participants

<table>
<thead>
<tr>
<th></th>
<th>A1 -</th>
<th>A1+</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (% energy)</td>
<td>34.7 (1.5)</td>
<td>41.7 (1.5)</td>
<td>0.002</td>
</tr>
<tr>
<td>Saturated fat (%</td>
<td>10.5 (0.6)</td>
<td>12.7 (0.6)</td>
<td>0.01</td>
</tr>
<tr>
<td>Carbohydrate (%</td>
<td>47.6 (1.7)</td>
<td>41.4 (1.8)</td>
<td>0.02</td>
</tr>
<tr>
<td>Cholesterol (mg/</td>
<td>144 (13)</td>
<td>197 (16)</td>
<td>0.02</td>
</tr>
<tr>
<td>Weight</td>
<td>99.2 (4.8)</td>
<td>110.4 (3.1)</td>
<td>0.05</td>
</tr>
</tbody>
</table>
### Diet and Body Weight by Genotype, White Participants

<table>
<thead>
<tr>
<th></th>
<th>A1 -</th>
<th>A1+</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (% energy)</td>
<td>36.3 (1.4)</td>
<td>32.8 (1.5)</td>
<td>0.09</td>
</tr>
<tr>
<td>Saturated fat (% energy)</td>
<td>12.0 (0.7)</td>
<td>11.0 (0.7)</td>
<td>0.31</td>
</tr>
<tr>
<td>Carbohydrate (% energy)</td>
<td>44.7 (2.0)</td>
<td>50.7 (1.6)</td>
<td>0.03</td>
</tr>
<tr>
<td>Cholesterol (mg/1000 kcal)</td>
<td>179 (16.7)</td>
<td>151 (22.9)</td>
<td>0.32</td>
</tr>
<tr>
<td>Weight</td>
<td>94.8 (4.4)</td>
<td>92.2 (5.0)</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Data shown are last values before any change to hypoglycemic medications carried forward.
Hemoglobin A1c, White Participants
(n = 25 vegan, 24 ADA)

Data shown are last values before any change to hypoglycemic medications carried forward.

White Vegan

White ADA

A1c (%)

P = 0.65
### A1c Changes with Diet Intervention (0-74 weeks)

<table>
<thead>
<tr>
<th></th>
<th>A1 -</th>
<th>A1+</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A1c change, blacks</strong></td>
<td>-0.72 (0.41)</td>
<td>-0.40 (0.27)</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>A1c change, whites</strong></td>
<td>-0.89 (0.27)</td>
<td>-0.02 (0.18)</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Substudy Hypothesis

The A1 allele may contribute to overeating and weight gain, increasing diabetes risk.
Can foods be addicting?
How to Magnetize a Baby
• Baby, 9 –12 weeks of age

• Sit face-to-face, 15 inches apart

1 tsp sugar + 1 cup water


University of Massachusetts at Amherst
University of Massachusetts at Amherst
Sugar → opiate release → ↑ dopamine
Sugar

- Reduces crying in healthy newborns
- Reduces visible reaction to heel-stick and circumcision
- No effect in infants of opiate-addicted mothers

<table>
<thead>
<tr>
<th>Item</th>
<th>Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar, 1 teaspoon</td>
<td>15</td>
</tr>
<tr>
<td>Chocolate chip cookies (2)</td>
<td>90</td>
</tr>
<tr>
<td>Soda, 20 ounces</td>
<td>250</td>
</tr>
<tr>
<td>Twizzlers (2.5 oz.)</td>
<td>263</td>
</tr>
</tbody>
</table>
Soda Serving Sizes

- 6-ounce bottles
- 12-ounce cans
- 16-ounce bottles
- 20-ounce bottles
Cola (20 oz.)

- 68 grams sugar + 78 mg caffeine
- 250 calories

Pennington, Bowes and Church's Food Values of Portions Commonly Used (Philadelphia: Lippincott-Raven, 1998)
Spot the Addicting Food
The Chocolate Drugstore

Caffeine (5-10 mg)*
Theobromine
Phenylethylamine
Slows breakdown of anandamide

*Compare to coffee (100 mg)
Casomorphins

Opiates that form as casein (milk protein) is digested.
# Casomorphins

**From β-casein:**

<table>
<thead>
<tr>
<th>Peptide</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-casomorphin-7</td>
<td>Try-Pro-Phe-Pro-Gly-Pro-Ile</td>
</tr>
<tr>
<td>β-casomorphin 5 (bovine)</td>
<td>Tyr-Pro-Phe-Pro-Gly</td>
</tr>
<tr>
<td>β-casomorphin 5 (human)</td>
<td>Tyr-Pro-Phe-Val-Glu</td>
</tr>
<tr>
<td>Morphiceptin</td>
<td>Tyr-Pro-Phe-Pro-NH₂</td>
</tr>
</tbody>
</table>

**From a$_{s1}$-casein:**

<table>
<thead>
<tr>
<th>Peptide</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-Casein exorphin</td>
<td>Arg-Gly-Phe-Gin-Asn-Ala</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cheese</th>
<th>Calories</th>
<th>Fat (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brie</td>
<td>190</td>
<td>16</td>
</tr>
<tr>
<td>Cheddar</td>
<td>228</td>
<td>19</td>
</tr>
<tr>
<td>Feta</td>
<td>150</td>
<td>12</td>
</tr>
<tr>
<td>Goat</td>
<td>206</td>
<td>17</td>
</tr>
<tr>
<td>Mozzarella</td>
<td>160</td>
<td>12</td>
</tr>
<tr>
<td>Swiss</td>
<td>214</td>
<td>16</td>
</tr>
</tbody>
</table>

Pennington, Bowes and Church's Food Values of Portions Commonly Used (Philadelphia: Lippincott-Raven, 1998)
<table>
<thead>
<tr>
<th>Food</th>
<th>Cholesterol (per ounce)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brie</td>
<td>28</td>
</tr>
<tr>
<td>Cheddar</td>
<td>30</td>
</tr>
<tr>
<td>Feta</td>
<td>25</td>
</tr>
<tr>
<td>Roast sirloin</td>
<td>25</td>
</tr>
<tr>
<td>Chicken breast, skinless</td>
<td>24</td>
</tr>
<tr>
<td>Salmon, Atlantic</td>
<td>20</td>
</tr>
<tr>
<td>Beans, grains</td>
<td>0</td>
</tr>
<tr>
<td>Vegetables, fruits</td>
<td>0</td>
</tr>
</tbody>
</table>

Pennington, Bowes and Church's Food Values of Portions Commonly Used (Philadelphia: Lippincott-Raven, 1998)
Cheese Lovers and "Triggering the Crave"

Cheese Forum
December 5, 2000

Ahh, the power of Cheese.
### Who are Cheese Lovers?

<table>
<thead>
<tr>
<th>Cravers</th>
<th>Enhancers</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Heaviest consuming segment</td>
<td>- HH consumption nearly as large as Craver HH</td>
</tr>
<tr>
<td>- Heavy Users aged 25 - 54</td>
<td>- Heavy Users aged 25-43</td>
</tr>
<tr>
<td>- Big “as is” consumers</td>
<td>- Incorporate cheese as an ingredient in meals</td>
</tr>
<tr>
<td>- Willingness to eat more cheese than they already do</td>
<td>- Slightly blue collar</td>
</tr>
<tr>
<td>- White Collar</td>
<td>- Larger Families</td>
</tr>
<tr>
<td>- Smaller Families</td>
<td></td>
</tr>
</tbody>
</table>

“Cheese Snackers”  

“Cheese Toppers”

Source: DMI
What do we want our integrated marketing program to do?

“Trigger”
the cheese craving
The U.S. Government at Work

Wendy’s “Cheddar Lover’s Bacon Cheeseburger” promotion sold:

- 2.25 million pounds of cheese
- 380 tons of fat
- 1.2 tons of pure cholesterol
The U.S. Government at Work

- Wendy’s “Cheddar Lover’s Bacon Cheeseburger”
- Subway’s “Chicken Cordon Bleu,” “Honey Pepper Melt”
- Pizza Hut’s “Ultimate Cheese Pizza”
- Burger King, Taco Bell
Dick Cooper, Vice President of Cheese Marketing, Dairy Management, Inc., at the “Cheese Forum,” December 5, 2000.
USDA Report to Congress on the Dairy Promotion Programs, 2000
“Would you give up meat for a week for $1,000?”

1,244 adults, surveyed April 2000

Answered “No”:

White Americans: 24%
Black Americans: 29%
Asian Americans: < 10%
Hispanic Americans: < 10%
Opiate Blocker Cuts Meat Appetite

Ham ↓ 10%
Salami ↓ 25%
Tuna ↓ ~ 50%

Benefits of Meatless Diets

- Reverse heart disease
- Lose ~ 10% of body weight
- ↓ cancer risk by ~ 40%
- ↓ blood pressure
- Improve or reverse diabetes
- ↓ risk of Alzheimer’s disease?
Top 5 Rationalizations

1. I’m a blood type O, so I have to eat meat.
2. I can exercise these extra calories off.
4. Healthy eating is expensive.
5. My grandfather smoked, drank, and ate all the wrong things and lived to be 90.
Care-Givers’ Rationalizations

1. There are no bad foods, only bad diets. Everything in moderation.

2. We have to follow people’s tastes and cultures.

3. My patients would rather just pop a pill.

4. We need more research before we can say anything.
Breaking Free from Food Cravings

1. Start with a healthy breakfast
2. Use foods to hold blood sugar steady
3. Dieters: Use the Rule of Ten
4. Break craving cycles
5. Have regular exercise and rest
6. Use social support
7. Take advantage of other motivators
Diabetes and Alzheimer’s Risk

1,017 adults
Hisayama, Japan

Risk of Alzheimer’s disease based on glucose tolerance results 15 years earlier.
Ohara T. Neurology. 2011;77:1126-34.
Diabetes and Alzheimer’s Risk

1,017 adults
Hisayama, Japan

Risk of Alzheimer’s disease based on glucose tolerance results 15 years earlier.
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Mechanisms

Cerebrovascular disease

Glucose toxicity
  Glycation of brain proteins
  Microvascular changes

Hyperinsulinemia
  Effects of insulin on brain vasculature
  Insulin $\uparrow$ $\beta$-amyloid secretion and $\downarrow$ elimination

Alzheimer's Prevalence in the U.S.

Hebert LE. Arch Neurol. 2003;60:1119-1122
Memory Problems

Lapses

Mild cognitive impairment

- Learning, remembering
- Reasoning
- Visual-spatial ability
- Language
- Personality

= Alzheimer’s disease
APOE epsilon-4 Allele

From one parent: 3x risk

From both parents: 10 - 15x risk
Cerebral Cortex. Stores memories as links between brain cells.

Hippocampus. Selects what needs to be remembered.
Add Up the Saturated Fat

2 large eggs                        3.2 g
1 slice bacon                      1.0 g
Chicken thigh, skinless            4.7 g
Whole milk (1 cup)                 4.6 g
DiGiorno Pizza for One             12.0 g

Total                            25.5 g
1,341 adults
Average age: 50
Followed 21 years

Cardiovascular risk factors, Aging, and Dementia (CAIDE) study, Finland
Mild Cognitive Impairment

1,341 adults
Average age: 50
Followed 21 years

Cardiovascular risk factors, Aging, and Dementia (CAIDE) study, Finland
Cholesterol and Alzheimer's Risk

9,844 participants in the Kaiser Permanente health plan.
Alzheimer's Risk

Saturated Fat per Day (grams)

Relative Risk

25.1  20.7  13.0
0  1  2  3  4

Alzheimer's Risk

Relative Risk

Saturated Fat per Day (grams)
Meat vs. Plant-Based Diets

Proportion remaining free of dementia

Loma Linda University, 272 participants
Meat vs. Plant-Based Diets

Proportion remaining free of dementia

Loma Linda University, 272 participants
Summary

Diet changes may be more challenging in the face of:

- adverse genetic traits
- easy availability of habit-forming foods
- rationalizations

Unhealthful foods contribute to diabetes and other health problems, including dementia.
Thank you!

Neal D. Barnard, MD
Adjunct Associate Professor of Medicine
The George Washington University School of Medicine
Physicians Committee for Responsible Medicine

pcrm.org