Dietary Interventions for Type 2 Diabetes and its Complications

Neal D. Barnard, MD
Anne Bunner, PhD
A Lesson from Japan
Diabetes Prevalence in Japan

In adults over age 40:

Prior to 1980: 1-5%

Rising Fat Intake in Japan

Fat (grams/day)


Murata M. Am J Clin Nutr 2000;72(suppl):1379S-83S.
Falling Carbohydrate Intake in Japan

Murata M. Am J Clin Nutr 2000;72(suppl):1379S-83S.
Overweight in Japan

BMI ≥ 25kg/m²

Women
Men

National Health and Nutrition Survey Japan, 2006
Diabetes Prevalence in Japan

In adults over age 40:

Prior to 1980: 1-5%

By 1990: 11-12%

A Lesson from the U.S.
U.S. Per Capita Meat Intake (lb)

U.S. Per Capita Chicken Intake (lb)

U.S. Per Capita Cheese Consumption (pounds)

U.S. per capita food consumption
Sugar and sweeteners (individual)

Dry weight, pounds per capita per year

Year

- Total selected commodities
- Cane and beet sugar
- Edible syrups
- Honey
- HFCS
- Glucose
- Dextrose

HFCS stands for high fructose corn syrup. Calculated from unrounded data.

Diabetes Prevalence 1994

[Map showing diabetes prevalence in different states.]

Legend:
- Missing Data
- < 4%
- 4 - 4.9%
- 5 - 5.9%
- 6+ %
Diabetes Prevalence 1995
Diabetes Prevalence 1996
Diabetes Prevalence 1997
Diabetes Prevalence 1998

[Map of the United States showing diabetes prevalence by state in 1998, with different colors indicating percentage ranges.]
Diabetes Prevalence 1999

[Map of the United States with different color codes indicating diabetes prevalence rates.]
Diabetes Prevalence 2000

[Map showing diabetes prevalence across the United States with different shades representing different percentage ranges.]

Legend:
- Missing Data
- 6+%
- 5–5.9%
- <4%
- 4–4.9%
Diabetes Prevalence 2001
Diabetes Prevalence 2002

The map shows the diabetes prevalence across the United States for the year 2002. The states are color-coded based on their diabetes prevalence rates:

- Missing Data
- 5–5.9%
- <4%
- 4–4.9%
- 6% and above
Diabetes Prevalence 2004
Diabetes Prevalence 2005
Diabetes Prevalence 2007

[Map showing diabetes prevalence across the United States with color coding for different prevalence ranges: 0 - 6.3, 6.4 - 7.5, 7.6 - 8.8, 8.9 - 10.5, ≥ 10.6]
Diabetes Prevalence 2008
Diabetes Prevalence 2009

www.cdc.gov/diabetes
Adventist Health Study – 2

60,903 participants, aged ≥30, enrolled 2002-2006

Weight-Control Study

Low-fat vegan diet

No exercise

14-week study
Typical Day’s Meals

Breakfast
Blueberry pancakes
or Oatmeal with cinnamon and raisins
Half cantaloupe
Rye toast with jam

Lunch
Chunky vegetable chili
Garden salad with sesame dressing

Snack
Banana

Dinner
Lentil soup with crackers
Linguine with artichoke hearts and seared oyster mushrooms
Steamed broccoli
Weight-Control Study

Low-fat vegan diet

No exercise

14-week study

→

13 lb average weight loss in 14 weeks

2-inch drop in waist measurement

Increased insulin sensitivity
Weight at 1 and 2 Years

Body Weight at Baseline and at 1- and 2-Year Follow-up

- **Control**
  - Year 1: 86.4 Kg
  - Year 2: 81.6 Kg

- **Vegan**
  - Year 1: 87.4 Kg
  - Year 2: 85.6 Kg

Plant-Based Dietary Intervention in Type 2 Diabetes

Neal D. Barnard, M.D.
Joshua Cohen, M.D.
David J.A. Jenkins, M.D., Ph.D.
Gabrielle Turner-McGrievy, M.S., R.D.
Lise Gloede, R.D., C.D.E.
Stanley Talpers, M.D.
Paul J. Poppen, Ph.D.
Amber Green, R.D.
Brent Jaster, M.D.
Kim Seidl, M.S., R.D
Susan Levin, R.D.
Earnest Noble, M.D.
Terry Ritchie, Ph.D.
Robyn Webb, M.S.

George Washington University
George Washington University
University of Toronto
University of North Carolina
Private practice, Arlington, VA
George Washington University
George Washington University
PCRM
PCRM
PCRM
PCRM

University of California, Los Angeles
University of California, Los Angeles
Robyn Webb Associates

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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
Study Completers

Vegan Group  ADA Group
N = 49       N = 50

Completers at 22 weeks  49 (100%)  50 (100%)
Completers at 74 weeks  42 (86%)    45 (90%)
Hemoglobin A1c at Baseline and at 11 and 22 Weeks

(n = 49 vegan, 50 ADA)

<table>
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<tr>
<th>Week</th>
<th>Vegan</th>
<th>ADA</th>
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<tbody>
<tr>
<td>0</td>
<td>8.05</td>
<td>7.93</td>
</tr>
<tr>
<td>11</td>
<td>7.34</td>
<td>7.33</td>
</tr>
<tr>
<td>22</td>
<td>7.37</td>
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P = .089
Hemoglobin A1c at Baseline and at 11 and 22 Weeks

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

Vegan
ADA

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

P = 0.01

A1c (%)
Data shown are last values before any change to hypoglycemic medications carried forward. For between-group comparison of changes from baseline to final values, $P = 0.03$. 

$P = 0.03$
Body Weight
(n = 49 vegan, 50 ADA)
(Missing values returned to baseline)

Weight (kg)

Week 0  Week 11  Week 22  Week 74
85
90
95
100
105

Vegan
ADA

93.3
96.7
97.0
99.3

P=0.36
(-3.7 from baseline)
(-2.6 from baseline)

P=0.36
Low Density Lipoprotein
Baseline to 74 Weeks or Last Value before Medication Change
(n = 49 vegan, 49 ADA)

Week 0
Week 74
80
90
100
110
120
130
Vegan
ADA
P = .001
104
91
118
114
-13%
LDL (mg/dl)
-3%
Vance

Lost 60 pounds
Stopped diabetes medications.
A1c fell from 9.5 to 5.3
Nancy

Lost 40 pounds
Stopped all diabetes medications.
A1c fell from 8.3 to 6.8.
Arthritis improved dramatically.
Inside the Cell

Glucose

Insulin

Intramyocellular lipid
Lifestyle Heart Trial

Dean Ornish, M.D.
Preventive Medicine
Research Institute
Sausalito, California

Randomized trial:

lifestyle intervention vs. usual care

Lifestyle Heart Trial

Experimental program:

1. Vegetarian foods
2. Half-hour walk daily
3. Manage stress
4. Avoid tobacco

# Lifestyle Heart Trial

<table>
<thead>
<tr>
<th></th>
<th>Experimental</th>
<th>Control</th>
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<tr>
<td>Cholesterol</td>
<td>↓ 24%</td>
<td>↓ 5%</td>
</tr>
<tr>
<td>LDL</td>
<td>↓ 37%</td>
<td>↓ 3%</td>
</tr>
<tr>
<td>Weight</td>
<td>↓ 22 lbs</td>
<td>↑ 3 lbs</td>
</tr>
<tr>
<td>Reversal</td>
<td>82% of participants</td>
<td>42% of participants</td>
</tr>
</tbody>
</table>

Cardiac Events* per Person Over 5-Year Follow-Up

*MI, angioplasty, bypass, cardiac-related hospitalization, or cardiac-related death.

Diabetic Neuropathy

- Among most common complications of diabetes
- Up to 50% of people with type 2 diabetes
- Pain, tingling, burning, annoying sensations, overly sensitive skin
Risk Factors for DN

- Cardiovascular Diseases
  - High blood pressure
  - Overweight/obesity
  - Triglycerides
  - Total Cholesterol
  - LDL Cholesterol
  - Smoking
  - Alcohol
  - Height

Manageable by lifestyle changes
Nerve cells are responsible for sensation and movement.

Large fiber nerves:
- movement and muscle control
- sensation of touch and vibration

DN Symptoms: numbness, tingling, muscle weakness, impaired reflexes
Nerve cells are responsible for sensation and movement

Small fiber nerves: temperature and pain sensation, sweating

DN Symptoms: painful or annoying sensations, hypersensitivity, excess/reduced sweating, poor wound healing
Skin Nerve Fiber Density

Assessed by Skin Biopsy

Normal Control       Diabetic Neuropathy

Treatment options are limited

Drugs treat pain, not underlying nerve damage.

Side effects:

- Anti-seizure medications: drowsiness
- Antidepressants: sedation
- Lidocaine patch: rash
- Opioids: addictive
Can a Low-fat Vegan Diet Help to Fight DN?

- 21 type 2 diabetes patients with DN
- Low-fat, high-fiber, vegan diet
- Moderate exercise
- 25 days

Can A Low-fat Vegan Diet Help to Fight DN?

- 81% had complete pain relief
- 4.9 kg average weight loss
- Reduced cholesterol by 13%
- 80% reduction in blood pressure medication
- 5 stopped diabetes medications, the rest reduced their dosages by 46%

Nerve regeneration with lifestyle change

- 32 pre-diabetes patients
- Nerve fiber density from skin biopsies
- 1 yr diet & exercise intervention resulting in weight loss (avg. BMI 32.1 to 31.0)
- 70% of participants experienced reinnervation

A low-fat vegan diet can improve diabetic neuropathy pain, sensory symptoms, and quality of life.
Recruitment

- Men and women 18-65 y
- Type 2 diabetes
- Painful diabetic neuropathy for at least 6 months

**Screened**
- (n = 71)

**Enrolled**
- (n= 35)

**Excluded:**
- Withdrew from consideration (10)
- Pain/symptoms did not meet criteria (5)
- No diabetic neuropathy (3)
- No diabetes (2)
- Did not meet other inclusion criteria (2)

**Group 1**
- (n = 17)
  - Withdrew (n = 0)
  - Completed (n= 17)

**Group 2**
- (n = 18)
  - Withdrew (n = 1)
  - Completed (n= 17)
Participant Baseline Characteristics

- 35 participants:
  - 46% Black, 3% Asian or Pacific Islander
  - 14% Hispanic
  - 54% college degree or higher
  - 54% women

- No significant differences between two groups
Intervention Arms

- Experimental: Vegan diet plus B12 supplement (1000 mcg/day)
- Control: B12 supplement only
- B12 used to eliminate risk of B12-deficiency related neuropathy
Diet Intervention

• Weekly classes with education and social support
• Email Listserv
• Meetings with dietician
Outcomes

 Evaluated:

- Dietary intake
- Body weight, blood pressure
- Neuropathy pain and symptoms, quality of life
- Glucose and HbA1c readings
- Blood lipids
Diet Adherence

Two-day diet records showed:

• X of X of diet group participants fully compliant with vegan diet.
  – X of X were low-fat (22%) at both assessments
  – X of X were low-fat at one of two assessments
• X of X participants fully compliant with low-fat guidelines, but not vegan guidelines
• X of X participants non-compliant
Diet Adherence

Changes in BMI and total cholesterol confirm diet adherence.
HbA1c and Quality of Life

Graph of HbA1c

Graph of QOL
Neuropathy Total Symptoms Score

Graph of NTSS-6

Graph of MPQ
Visual Analog Pain Scale

Both groups had significant decline.

Graph of VAS
Patients’ global impression of change

How different is your pain from the start of the study?

1 = No change (or condition has got worse)
2 = Almost the same
3 = A little better
4 = Somewhat better
5 = Moderately better
6 = Better
7 = A great deal better

Graph of PGIC
Summary of Conclusions

- In this 20-week intervention, diet group participants showed greater improvements in [measures to be added after data analysis].

- This study demonstrates the potential of diet interventions for treating diabetic neuropathy pain and lays the groundwork for a larger study.
Three Keys:

1. Vegan
2. Low in fats and oils
3. Low-glycemic index
Beginning a Healthful Diet

Step 1. Check out the possibilities
Foods to Try

Breakfast

Lunch

Dinner

Snack
Healthy Breakfasts

• Cinnamon Raisin Oatmeal
  • Blueberry Pancakes
• Hot Whole Wheat with Dates
  • Breakfast Scrambler
  • Fantastic Fruit Smoothie
• Whole-Grain Bagel with Jam
  • Swiss Style Muesli
• Slow Cooker Whole-Grain Porridge
  • Orange-Pineapple Crush
Lunches and Dinners

• Chunky Vegetable Chili
• Chuckwagon Stew
• Seitan & Mushroom Stroganoff
• Portobello Mushroom Steaks
• Oven-Barbecued Tofu Steaks
  • Roadhouse Hash
• Sweet & Sour Tempeh
• Southern Beans & Greens
  • Seitan Cassoulet
  • Mandarin Stir-Fry
• Stuffed Vegetable Rolls
• Zucchini & Herb Calzones
  • Chili Bean Macaroni
Italian Cuisine
Mexican Cuisine
Chinese Cuisine
Japanese Cuisine
Fast-Food Options

Veggie sub

Bean burrito, hold the cheese
Beginning a Healthful Diet

Step 1. Check out the possibilities

Step 2. Do a 3-week test drive

Optional: Use transition foods
Physicians Committee for Responsible Medicine
PCRM.ORG