Changes in Body Weight in Clinical Trials Using Vegetarian Diets

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Adventist Health Study – 2

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

European Prospective Investigation into Cancer and Nutrition (EPIC)

N = 37,875; aged 20 – 97; enrolled 1993 - 1999

Lifestyle Heart Trial

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

Body Weight at 1 and 5 Years

Weight-Control Study in Overweight Women

64 overweight, postmenopausal women

Low-fat vegan diet

No exercise

14-week study, 2-year follow-up
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
14-Week Results

Low-fat vegan diet → 5.8 kg (13 lb) weight loss
No exercise ↑ insulin sensitivity

Weight at 1 and 2 Years

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

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

Week 0
Week 11
Week 22
Week 74

Vegan

ADA

Weight (kg)

P=0.36

(-3.7 from baseline)

(-2.6 from baseline)
There were a few missteps along the way...

Vegan Burger with Bacon & Cheese

Quarter pound vegan burger topped with bacon and cheese on kaiser served with your choice of two house sides

$5.99
Body Weight


<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Study Week</th>
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<tbody>
<tr>
<td>100.1</td>
<td>Vegan</td>
</tr>
<tr>
<td>99.9</td>
<td>Control</td>
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<tr>
<td>100.3</td>
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-5.1 kg, P < 0.0001
Hillary and Bruce
GEICO Multicenter Trial

- 10 cities, 292 men and women
- BMI $\geq 25 \text{ kg/m}^2$ or type 2 diabetes
- Random assignment by site
- 18 weeks (January – May 2011)
Study Sites

- Buffalo, NY
- Woodbury, NY
- Chevy Chase, MD
- Virginia Beach, VA
- San Diego, CA
- Tucson, AZ
- Dallas, TX
- Macon, GA
- Lakeland, FL
Body Weight

-2.9 kg, P < 0.001

Systematic Review and Meta-Analysis

Purpose: To estimate the effect on body weight of the adoption of vegetarian (including vegan) diets
Inclusion Criteria

• Intervention trials
• Adults
• Vegetarian (including vegan) diet
• \( \geq 4 \) weeks’ duration
Exclusion Criteria

- Controlled energy intake
- Exercise or fasting
- Medical conditions affecting weight
Literature Search

PubMed, EMBASE, Cochrane Central Register of Controlled Trials

Online search: 245
Reference search: 53
Included in review: 15
Included in meta-analysis: 10
Handling Missing Data

1. Baseline values
2. Omit
Weight Change in Plant-Based Intervention Trials
(Baseline values used for missing data)

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<tr>
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-3.1 kg (p<0.001)
Weight Change in Plant-Based Intervention Trials
(Missing values omitted)

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-4.0 kg (p<0.001)
Effect of Baseline Weight on Weight Change
(Baseline values used for missing data)

Regression of Baseline weight on Mean

Effect of Baseline Weight on Weight Change
(Baseline values used for missing data)

Regression of Baseline weight on Mean

P=0.005
Effect of Gender on Weight Change  
(Baseline values used for missing data)

Regression of Sex (Women %) on Mean

slope 0.034, P=0.022
Effect of Age on Weight Change
(Baseline values used for missing data)

Regression of Age on Mean

slope -0.008, P=0.86
Effect of Age on Weight Change
(missing values omitted)

Regression of Age on Mean

slope -0.100, P=0.0017
Diet Types

(Baseline values used for missing data)

Vegan: -3.2kg

Ovo-lacto: -3.1kg

P=0.62
Effect of Study Duration on Weight Change
(baseline values used for missing data)

Regression of Duration (wk) on Mean

P=0.388
Effect of Study Duration on Weight Change

(missing values omitted)

Regression of Duration (wk) on Mean

P=0.007
Effect of Authorship on Weight Change
(baseline values used for missing data)

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-2.5kg

-3.1kg

P=0.077
Effect of Authorship on Weight Change

(missing values omitted)

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-4.0 kg

P<0.001
How Does It Work?
Fiber Tricks the Brain

Fiber tells the brain you’re full.
The After-Meal Calorie Burn

- Meal
- 1 Hour
- 2 Hours
- 3 Hours
The After-Meal Calorie Burn

Meal 1 Hour 2 Hours 3 Hours
Mitochondria
Fat Interferes with Calorie Burning

Intramyocellular lipid  Mitochondria
Fat Interferes with Calorie Burning

Intramyocellular lipid

Mitochondria
Fat Interferes with Calorie Burning

Intramyocellular lipid

Mitochondria
Fat Interferes with Calorie Burning

Intramycellular lipid

Mitochondria
Inside the Cell

Glucose

Insulin

Intramyocellular lipid
Getting fat out of cells boosts your after-meal calorie burn.
Acceptability

- No artificial calorie limits.
- No portion sizes.
- No carbohydrate-counting.
- Benefits encourage adherence.
Acceptability

Acceptability is similar to that of other therapeutic diets.

- Men and women with heart disease (1992)
- Young women with dysmenorrhea (2000)
- Postmenopausal overweight women (2004)
- Men and women with diabetes (2008)

Midlife BMI and Dementia Risk

Swedish Twin Registry

Diabetes and Alzheimer’s Risk

Systematic review of 14 studies

Diabetes (type 1 or 2) increases risk of:
- Alzheimer’s disease: 50-100%
- Vascular dementia: 100-150%

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.
Summary

Vegetarian (ovo-lacto and vegan) diets reliably cause weight loss.

Quantity of weight lost depends on beginning weight, and may be affected by gender and age.
Acknowledgements

- Susan Levin, MS, RD
- Yoko Yokoyama, PhD
- Richard Holubkov, PhD
Thank you!
Thank you!
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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

Forest Plot: 95% Confidence Interval

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<tr>
<th>Study Name</th>
<th>N</th>
<th>Confidence Interval</th>
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<td>Kjeldsen (1991)</td>
<td>27</td>
<td>-2.900 (-4.182, -1.618)</td>
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<tr>
<td>Nenonen (1998)</td>
<td>22</td>
<td>-1.800 (-2.761, -0.839)</td>
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<td>Dansinger (2005)</td>
<td>40</td>
<td>-3.300 (-5.562, -1.038)</td>
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<td>Turner (2007)</td>
<td>31</td>
<td>-3.600 (-5.994, -1.206)</td>
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<td>Mishra (Unpub)</td>
<td>119</td>
<td>-3.000 (-3.773, -2.227)</td>
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<td>Gardner (2007)</td>
<td>76</td>
<td>-2.600 (-3.850, -1.350)</td>
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<td>Barnard (2009)</td>
<td>49</td>
<td>-3.700 (-5.464, -1.936)</td>
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<td>Ferdowsian (2010)</td>
<td>68</td>
<td>-5.100 (-6.276, -3.924)</td>
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<td>Mishra (Unpub 2)</td>
<td>142</td>
<td>-3.000 (-3.666, -2.334)</td>
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<td>Overall</td>
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<td>-3.029 (-3.571, -2.487)</td>
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Effect of Baseline Weight on Weight Change

(missing values omitted)

Regression of Baseline weight on Mean

Baseline weight vs. Mean

Baseline weight: 64.50, 68.70, 72.90, 77.10, 81.30, 85.50, 89.70, 93.90, 98.10, 102.30, 106.50

Mean: -2.00, -2.60, -3.20, -3.80, -4.40, -5.00, -5.60, -6.20, -6.80, -7.40

P<0.001
Effect of Gender on Weight Change (missing values omitted)

Regression of Sex (Women %) on Mean

slope 0.070, P=0.00002
Diet Types

(Missing values omitted)

Vegan: -3.8kg

Ovo-lacto: -5.1kg

P=0.28