Experiences from the PREDIMED Study & Other Clinical Trials: Effects on Cardiovascular Biomarkers & More

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Disclosures

- Honorarium
  - California Walnut Commission
Outline

- Mediterranean diet: Definitions and health benefits
- Components of the Mediterranean diet
- Mechanisms of action underlying the cardioprotective effects of the Mediterranean diet
Outline

- Use of the Mediterranean diet with patients diagnosed with various chronic illnesses

- Practical patient counseling approaches to successfully achieve a Mediterranean-style eating pattern
Mediterranean Diet: What is it?

- A diet that differs somewhat by country, but which is generally characterized by increased consumption of olive oil, complex carbohydrates, vegetables, fish, and decreased red meat and pork consumption. (Segen's Medical Dictionary)

- The Mediterranean Diet is a way of eating based on the traditional foods (and drinks) of the countries surrounding the Mediterranean Sea. (Oldways Preservation Trust)
The Mediterranean Diet is the name given to eating plans typical of countries of the Mediterranean, with Greece, Italy and Spain being the main points of reference.

(Everything Mediterranean Diet Book, 2010)
Components of Mediterranean Diet

- **Plant–based foods**
  - Vegetables, fruits
  - Whole grains
  - Beans, legumes
  - Nuts, seeds
  - Herbs, spices
  - Olives, olive oil

- **Protein**
  - Fish and other protein 2x/week

- **Omega–3 fatty acids**
  - Fatty fish
  - Walnuts

- **Alcohol (optional)**
  - Red wine with meals
Foods of the Mediterranean
Health Benefits of Mediterranean Diet

- Whole dietary and lifestyle pattern seems to be key
  - The diet also recognizes the importance of being physically active, and enjoying meals with family and friends

- Helps reduce risk of:
  - Alzheimer’s disease
  - Parkinson’s disease
  - Cancer
  - Diabetes
  - Cardiovascular disease (CVD)
Health Benefits of Mediterranean Diet

- Focus on fruits and vegetables
  - Residents of Greece average 6 or more servings a day of antioxidant-rich fruits and vegetables

- Grains in the Mediterranean region are typically whole grain
  - Bread is eaten plain or dipped in olive oil — not eaten with butter or margarine, which contains saturated or trans fats
Health Benefits of Mediterranean Diet

- Consumption of **anti-inflammatory** foods
  - Omega-3 fatty acids
  - Extra virgin olive oil
  - Antioxidant rich fruits and vegetables
  - Spices

- Nuts are a part of a healthy Mediterranean diet, and most of the fat is healthy
  - Provide protein, fiber and flavor
## Components in Nuts and Possible Mechanisms of Action for Cardioprotection

<table>
<thead>
<tr>
<th>Nut Component:</th>
<th>Mechanism:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High in unsaturated fats: Polyunsaturated Monounsaturated</td>
<td>Lowers total cholesterol Improves lipid profile</td>
</tr>
<tr>
<td>Nut proteins are: High in arginine Low in lysine</td>
<td>Lowers LDL levels Precursor of nitric oxide (endothelium derived relaxing factor)</td>
</tr>
<tr>
<td>Dietary fiber (soluble)</td>
<td>Lowers LDL levels</td>
</tr>
<tr>
<td>Tocopherols</td>
<td>Reduces LDL oxidation</td>
</tr>
</tbody>
</table>
## Components in Nuts and Possible Mechanisms of Action for Cardioprotection

<table>
<thead>
<tr>
<th>Nut Component:</th>
<th>Mechanism:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folic acid</td>
<td>Decreases blood homocysteine levels</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Prevents ventricle arrhythmia</td>
</tr>
<tr>
<td>Copper</td>
<td>Association with decreased blood cholesterol, blood pressure</td>
</tr>
<tr>
<td>Phytochemicals</td>
<td>Antioxidant potential</td>
</tr>
</tbody>
</table>
Types of Dietary Fat

- Saturated = “BAD FAT”
  - Trans

- Unsaturated = “GOOD FAT”
  - Monounsaturated
  - Polyunsaturated
The “Good” Fats

Monounsaturated Fat (MUFA)
- Increases HDL, the “good” cholesterol

Polyunsaturated Fat (PUFA)
- Two types of “polys”
  - Omega-6
  - Omega-3
- Omega-6s
  - Lower cholesterol when replacing saturated fat
- Omega-3s
  - Lower TG while helping maintain HDL
  - Walnuts contain very high levels of α-linolenic acid (ALA; plant-based omega-3)
    - Fatty fish, fish oil capsules
Omega 3 Fatty Acids

- According to AHA, very beneficial for preventing CVD, arrhythmias, blood pressure and plaque

- Sources:
  - Fatty fish (salmon, tuna, sardines, trout) = EPA and DHA,
  - Walnuts, flaxseed, canola oil = ALA

- Minimum of 2 servings of fish/week

- Current guidelines: 1000 mg/day for those with existing CVD

Americanheart.org Accessed February 26, 2014
Omega 6 Fatty Acids

- According to AHA, beneficial for preventing CVD; helps reduce blood cholesterol

- Sources
  - Nuts, seeds
  - Sunflower, safflower, corn and soybean oils
  - Soft spread margarines

- Up to 5–10% of calories

Americanheart.org Accessed February 26, 2014
Conclusion for plant omega-3 fatty acids:

“Alpha-linolenic acid (ALA) intake of 0.6-1.2% of energy will meet current recommendations and may lower CVD risk, but new evidence is insufficient to warrant greater intake beyond this level. Limited but supportive evidence suggests that higher intake of n-3 from plant sources may reduce mortality among persons with existing CVD.”
comparison of dietary fats

<table>
<thead>
<tr>
<th></th>
<th>Saturated Fat</th>
<th>Polyunsaturated Fat</th>
<th>Monounsaturated Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola oil</td>
<td>7</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>Safflower oil</td>
<td>8</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Flaxseed oil</td>
<td>9</td>
<td>16</td>
<td>57</td>
</tr>
<tr>
<td>Sunflower oil</td>
<td>12</td>
<td>71</td>
<td>1</td>
</tr>
<tr>
<td>Corn oil</td>
<td>13</td>
<td>57</td>
<td>1</td>
</tr>
<tr>
<td>Olive oil</td>
<td>15</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>15</td>
<td>54</td>
<td>8</td>
</tr>
<tr>
<td>Peanut oil</td>
<td>19</td>
<td>33</td>
<td>*</td>
</tr>
<tr>
<td>Cottonseed oil</td>
<td>27</td>
<td>54</td>
<td>*</td>
</tr>
<tr>
<td>Lard</td>
<td>43</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Palm oil</td>
<td>51</td>
<td>10</td>
<td>*</td>
</tr>
<tr>
<td>Butter</td>
<td>68</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>91</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

*High oleic safflower oil

ALA
Fatty Acid Content of Nuts and Seeds

- Almond
- Brazil
- Cashew
- Hazelnut
- Macadamia
- Peanut
- Pecan
- Pine nut
- Pistachio
- Sesame
- Walnut

SFA | MUFA | Omega 6 | Omega 3
---|---|---|---
0% | 20% | 40% | 60% | 80% | 100% | ALA
Effects of walnuts on serum lipid levels and blood pressure in normal men

Sabaté J et al., *NEJM* 1993;89:328:603–607
Walnut Study

- **OBJECTIVE:** To evaluate the effects of walnut consumption on serum lipids and blood pressure

- **DESIGN:** A randomized, crossover feeding trial in 18 healthy males

- **METHODS:** 20% of calories from walnuts vs. walnut-free NCEP “Step 1” diet, 4 week interventions

Sabaté J et al., *NEJM* 1993;328:603–607
Walnut Study

Study Diets

- **100% Energy from NCEP Step 1 Diet**
  - **Control Diet**
  - % En from total fat: 30
  - % En from S/M/P fat: 10/10/10

- **20% Walnut Diet**
  - 80% Energy from NCEP Step 1 Diet
  - **Walnut Diet**
  - % En from total fat: 31
  - % En from S/M/P fat: 6/8/16

Sabaté J et al., *NEJM* 1993;328:603–607
## Results: Blood lipid levels at the end of each diet period

<table>
<thead>
<tr>
<th></th>
<th>Step 1 Diet</th>
<th>Walnut Diet</th>
<th>Walnut Diet Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mg/dL</td>
<td>%</td>
<td>P value</td>
</tr>
<tr>
<td>Total-C</td>
<td>182±23</td>
<td>160±23</td>
<td>-22.4</td>
</tr>
<tr>
<td>LDL-C</td>
<td>112±16</td>
<td>94±17</td>
<td>-18.2</td>
</tr>
<tr>
<td>HDL-C</td>
<td>47±11</td>
<td>45±10</td>
<td>-2.3</td>
</tr>
<tr>
<td>LDL-C/HDL-C</td>
<td>2.5±0.6</td>
<td>2.2±0.7</td>
<td>-0.3</td>
</tr>
<tr>
<td>TG</td>
<td>114±59</td>
<td>103±45</td>
<td>-9.5</td>
</tr>
</tbody>
</table>

Sabaté J et al., *NEJM* 1993;328:603–607
Incorporating moderate quantities of walnuts into the recommended cholesterol-lowering diet while maintaining the intake of total dietary fat and calories decreases serum levels of total cholesterol and favorably modifies the lipoprotein profile in normal men.

Sabaté J et al., *NEJM* 1993;328:603–607
Walnuts and fatty fish influence different serum lipid fractions in normal to mildly hyperlipidemic individuals: a randomized controlled study

Rajaram S et al., AJCN 2009;89:1657S–1663S
Walnut and Fish Study

- **OBJECTIVE:** To determine whether walnuts (plant n-3 fatty acid) and salmon (marine n-3 fatty acid) have similar effects on blood lipids

- **DESIGN:** A randomized, crossover feeding trial in 25 normal to mildly hyperlipidemic adults

- **METHODS:** 2 servings salmon/week vs. 1.5 oz/day walnuts, 4-week interventions

Rajaram S et al., *AJCN* 2009;89:1657S–1663S
Results: The mean +/-SE percentage difference in lipids in walnut and fish diets compared with the control diet

- **Walnut vs. control diet**
- **Fish vs. control diet**

Rajaram S et al., *AJCN* 2009;89:1657S–1663S
Walnut and Fish Study

- **Walnuts (1 ½ oz)**
  - Amount based on the 2004 Food and Drug Administration qualified health claim
  - Source of ALA

Results:

- ↓TC
- ↓LDL
- ↓LDL:HDL
- ↓apo B:apo A1

Rajaram S et al., *AJCN* 2009;89:1657S–1663S
Walnut and Fish Study

- **Fatty fish (4 oz. salmon twice/week)**
  - Amount based on 2006 American Heart Association guidelines
  - Source of EPA and DHA (0.78 g/day of EPA + DHA)

**Results:**
- ↓TG
- ↑HDL
- ↑TC
- ↑LDL:HDL
- ↑apoB:apoA1

Rajaram S et al., AJCN 2009;89:1657S–1663S
Conclusions

- **Combining** walnuts with fatty fish (salmon) **may** help blunt the total cholesterol and LDL raising effect of fatty fish
  - Provides a more comprehensive way of managing mild to moderate hyperlipidemia
Nut consumption and blood lipid levels: a pooled analysis of 25 intervention trials

Sabaté J et al., Arch Intern Med 2010;170(9):821–827
Pooled Analysis

- **OBJECTIVE:** To estimate the effects of nut consumption on blood lipid levels and to examine whether different factors modify the effects

- **DESIGN:** Pooled analysis of individual primary data from 25 nut consumption trials conducted in 7 countries among 583 men and women with normolipidemia and hypercholesterolemia who were not taking lipid-lowering medications

- **METHODS:** MEDLINE search conducted to identify trials between 1992–2004

Sabaté J et al., *Arch Intern Med* 2010;170:821–827
Results: “A dose relationship was found”

Sabaté J et al., *Arch Intern Med* 2010;170:821–827
Results: Changes by baseline LDL-C levels

* $P < 0.001$ and † $P < 0.05$ for difference between nut diet and control diet

Sabaté J et al., Arch Intern Med 2010;170:821–827
Results: Changes by BMI category

* $P < 0.001$ and † $P < 0.05$ for difference between nut diet and control diet

Sabaté J et al., Arch Intern Med 2010;170:821–827
Conclusions

- The cholesterol lowering effect of nuts is dose-related

- It is more pronounced in persons with higher LDL-C or lower BMI

- Nuts lower triglycerides in participants with hypertriglyceridemia
Effect of a Mediterranean diet supplemented with nuts on metabolic syndrome status: one-year results of the PREDIMED randomized trial

Main PREDIMED Trial: Study Design

- Men: 55-80 yr
- Women: 60-80 yr
- High CVD risk without CVD
  - Type 2 diabetes
  - 3+ CVD risk factors

Randomize

1. Smoking
2. Hypertension
3. ↑ LDL
4. ↓ HDL
5. Overweight/obese
6. Family history

All free of CVD at baseline
Main PREDIMED Study: Flow Chart

7500 subjects at high risk for CVD

Assessed for eligibility

MedDiet + VOO  
\( n=2500 \)

MedDiet + NUTS  
\( n=2500 \)

CONTROL GROUP  
\( n=2500 \)

MedDiet groups: Received personal educational interviews to negotiate nutritional goals and either extra virgin olive oil (1L/wk) or 15 grams of walnuts and 7.5 grams of almonds and 7.5 grams of hazelnuts per day.

Control group: Received guidelines of the National Cholesterol Education Program.
Nut Intervention Group

30 g (~1 oz) of nuts per day

- 50% walnuts (15 g; ~½ oz)
- 25% almonds (7.5 g; ~¼ oz)
- 25% hazelnuts (7.5 g; ~¼ oz)
PREDIMED (Prevención con Dieta Mediterránea) Study

- OBJECTIVE: To compare the 1–year effect of 2 MedDiet interventions vs. advice on a low-fat diet on the prevention and resolution of metabolic syndrome (MetS)

- DESIGN: Randomized controlled clinical trial, multicenter, 3–arm, parallel–group

- METHODS: 1224 participants were recruited from the PREDIMED study to determine the efficacy of the 2 MedDiet interventions over a 1–year period

Results: Baseline and 1-year prevalence of MetS by diet assignment

Salas-Salvado J et al., Arch Intern Med 2008;168:2449-2458
Results: 1-year resolution (top) and incidence (bottom) of MetS

- **Metabolic syndrome resolution**
  - Control group
  - MedDiet + VOO: OR = 1.3 (95% CI, 0.8–2.1) (N/S)
  - MedDiet + Nuts: OR = 1.7 (95% CI, 1.1–2.6) (p<0.05)

- **Metabolic syndrome incidence**
  - Incident rates of MetS were not significantly different among groups.

Salas-Salvado J et al., *Arch Intern Med* 2008;168:2449-2458
Results

- After 1 year, MetS prevalence decreased by
  - 6.7% in MedDiet + VOO group
  - 13.7% in MedDiet + nuts group (p=0.01)
  - 2.0% in control group

- MedDiet + nuts group was associated with MetS resolution
  - OR = 1.7 (95% CI, 1.1–2.6; p<0.05)
  - “Participants in the MedDiet + nuts group had a 70% increased odds of having their MetS resolved”

Conclusions

“A traditional MedDiet enriched with nuts could be a useful tool in the management of the MetS.”
A walnut diet improves endothelial function in hypercholesterolemic subjects: a randomized crossover trial

Ros E et al., *Circulation* 2004;109:1609–1614
OBJECTIVE: To test the hypothesis that walnut intake will reverse endothelial dysfunction

DESIGN: Randomized, crossover design

METHODS: 21 hypercholesterolemic men and women consumed a walnut–free Mediterranean diet and a Mediterranean diet with walnuts at 18% of total energy (32% of the energy from MUFA), 4 week interventions

Ros E et al., Circulation 2004;109:1609-1614
Results: Four weeks of walnut consumption (~1½–2½ oz/d) improved postprandial brachial artery EDV compared to a walnut–free Mediterranean diet

Ros E et al., Circulation 2004;109:1609–1614
Conclusions

“Substituting walnuts for monounsaturated fat in a Mediterranean diet improves endothelium-dependent vasodilation in hypercholesterolemic subjects. This finding might explain the cardioprotective effect of nut intake beyond cholesterol lowering.”
Nuts, especially walnuts, have both antioxidant quantity and efficacy and exhibit significant potential health benefits

Vinson J and Cai Y *Food Funct* 2012;3:134–140
Background and Objective

- Nuts are high in polyphenols (antioxidants) which by binding to lipoproteins would inhibit oxidative processes that lead to atherosclerosis.

- The efficacy of raw and roasted nut antioxidants was assessed by measuring the ability of free polyphenol nut extracts to inhibit the oxidation of lower density lipoproteins (LDL + VLDL).
  - A nut polyphenol, catechin, was measured after binding of nut extracts to lower density lipoproteins.
### Results: Free and total polyphenols in nuts and peanut butter (μmol catechin equivalents/g)

<table>
<thead>
<tr>
<th>Nut</th>
<th>Raw Free</th>
<th>Raw Total</th>
<th>Roasted Free</th>
<th>Roasted Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond (n = 11)</td>
<td>34.8 ± 1.1 (34.0 to 36.0)</td>
<td>48.0 ± 28.9 (27.5 to 68.4)</td>
<td>36.8 ± 7.4 (25.7 to 47.8)</td>
<td>44.8 ± 2.0 (29.2 to 74.8)</td>
</tr>
<tr>
<td>Brazil (n = 4)</td>
<td>33.7 ± 0.0 (33.7)</td>
<td>66.1 ± 8.8 (59.8 to 72.3)</td>
<td>17.0 ± 0.8 (16.4 to 17.6)</td>
<td>73.2 ± 8.5 (67.2 to 79.2)</td>
</tr>
<tr>
<td>Cashew (n = 7)</td>
<td>21.0 ± 1.6 (17.9 to 22.8)</td>
<td>28.6 ± 2.3 (25.9 to 30.2)</td>
<td>19.3 ± 2.5 (17.9 to 22.1)</td>
<td>49.3 ± 24.0 (26.4 to 71.6)</td>
</tr>
<tr>
<td>Hazelnut (n = 4)</td>
<td>21.6 ± 0.6 (21.2 to 22.0)</td>
<td>26.7 ± 2.0 (25.3 to 28.1)</td>
<td>22.6 ± 0.6 (20.4 to 23.1)</td>
<td>61.4 ± 43.6 (38.5 to 100)</td>
</tr>
<tr>
<td>Macadamia (n = 4)</td>
<td>15.0 ± 2.9 (12.9 to 17.0)</td>
<td>39.1 ± 10.1 (31.9 to 46.2)</td>
<td>11.1 ± 4.2 (8.1 to 14.0)</td>
<td>45.1 ± 23.2 (28.6 to 61.5)</td>
</tr>
<tr>
<td>Peanut (n = 6)</td>
<td>24.0 ± 4.1 (21.1 to 26.9)</td>
<td>48.5 ± 9.4 (41.8 to 55.1)</td>
<td>8.7 ± 5. (13.7 to 22.8)</td>
<td>50.3 ± 24.0 (27.5 to 73.5)</td>
</tr>
<tr>
<td>Peanut Butter (Creamy) (n = 2)</td>
<td>N/A</td>
<td>N/A</td>
<td>16.2 ± 0.4 (15.9 to 16.5)</td>
<td>33.5 ± 7.6 (28.1 to 38.9)</td>
</tr>
<tr>
<td>Peanut Butter (Crunchy) (n = 2)</td>
<td>N/A</td>
<td>N/A</td>
<td>16.0 ± 0.8 (14.5 to 15.4)</td>
<td>32.5 ± 1.8 (31.2 to 33.8)</td>
</tr>
<tr>
<td>Pecan (n = 4)</td>
<td>22.3 ± 3.4 (19.9 to 24.7)</td>
<td>49.9 ± 23.1 (33.5 to 66.2)</td>
<td>16.6 ± 0.6 (16.2 to 17.0)</td>
<td>50.0 ± 17.9 (37.4 to 62.7)</td>
</tr>
<tr>
<td>Pistachio (n = 6)</td>
<td>15.8 ± 1.7 (14.6 to 17.0)</td>
<td>51.9 ± 0.4 (51.6 to 52.1)</td>
<td>19.9 ± 3.7 (15.4 to 20.8)</td>
<td>39.7 ± 24.5 (25.3 to 76.1)</td>
</tr>
<tr>
<td>Walnut (n = 4)</td>
<td>31.9 ± 6.9 (27.0 to 36.8)</td>
<td>69.3 ± 16.5 (57.6 to 81.0)</td>
<td>65.5 ± 9.1 (59.1 to 71.9)</td>
<td>107 ± 12.1 (97.9 to 115)</td>
</tr>
</tbody>
</table>
Antioxidant efficacy of nut and peanut butter polyphenols as measured by the concentration to inhibit the oxidation of LDL and VLDL by 50% compared to control with no added antioxidants.
Conclusions

- Raw and roasted walnuts had the highest total polyphenols
- Walnut polyphenols had the best efficacy among the nuts and also the highest lipoprotein-bound antioxidant activity
Decreasing the linoleic acid (omega-6) to alpha-linolenic acid (omega-3) diet ratio increases eicosapentaenoic acid in erythrocytes in adults

Wien et al., *Lipids* 2010;45:683–692
Dietary intakes of linoleic acid (omega-6) have increased over the last century

- ~3% energy in early 1900s
- 5–7% energy of current Western-style diets

10:1 diet ratio is linked to CVD

- Western-style diet
- High intake of corn, safflower and sunflower oil

2:1 diet ratio is protective

- Mediterranean-style diet
- High intake of olive oil and walnuts

Wien et al. *Lipids* 2010;45:683–692
OBJECTIVE: Compare the accretion of EPA and DHA into erythrocyte membranes

DESIGN: Randomized controlled trial, 2x2 factorial crossover design

METHODS: 24 healthy men and women consumed three of four 8-week diet interventions

Wien et al. *Lipids* 2010;45:683–692
# Dietary Sources of ALA

<table>
<thead>
<tr>
<th>Food item</th>
<th>ALA (g/tbsp or 28 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin seeds</td>
<td>0.051</td>
</tr>
<tr>
<td>Olive oil</td>
<td>0.103</td>
</tr>
<tr>
<td>Walnuts, black</td>
<td>0.156</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>1.231</td>
</tr>
<tr>
<td>Rapeseed (canola) oil</td>
<td>1.302</td>
</tr>
<tr>
<td>Walnut oil</td>
<td>1.414</td>
</tr>
<tr>
<td>Flaxseeds</td>
<td>2.350</td>
</tr>
<tr>
<td><strong>Walnuts</strong></td>
<td>2.574</td>
</tr>
<tr>
<td>Flaxseed oil</td>
<td>7.249</td>
</tr>
<tr>
<td></td>
<td>10:1 “Control” Diet</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Supplement</strong></td>
<td>• No ALA rich foods</td>
</tr>
<tr>
<td>Z</td>
<td>• LA/ALA ratio 10:1</td>
</tr>
<tr>
<td></td>
<td>• No EPA/DHA supplementation (S)</td>
</tr>
<tr>
<td><strong>Y</strong></td>
<td>10:1 “Control” Diet + S</td>
</tr>
<tr>
<td></td>
<td>• No ALA rich foods</td>
</tr>
<tr>
<td></td>
<td>• LA/ALA ratio 10:1</td>
</tr>
<tr>
<td></td>
<td>• EPA/DHA supplementation (S)</td>
</tr>
</tbody>
</table>

2x2 Factorial Design:
Diet (10:1 vs. 2:1) x EPA/DHA supplementation (Yes/No)
Results: Erythrocyte accretion compared to Western “Control” diet (10:1)

- **EPA**
  - Algal oil supplement (10:1 + S): ↑34% (P=0.02)
  - Flax/walnut (2:1): ↑60% (P<0.0001)
  - Flax/walnut + algal oil supplement (2:1 + S): ↑94% (P<0.0001)

- **DHA**
  - Algal oil supplement(10:1 + S): ↑41% (P<0.001)
  - Flax/walnut (2:1): NO CHANGE
  - Flax/walnut + algal oil supplement (2:1 + S): ↑31% (P<0.01)

Wien et al. *Lipids* 2010;45:683–692
“At the population level, a decreased intake of omega-6 fatty acids with an increased intake of plant sources of omega-3 fatty acids (ALA from flax and walnuts) plus omega-3 fatty acids (EPA + DHA) from an algal oil supplement is a sustainable alternative to consuming fish or fish oil to achieve a more favorable Mediterranean-type diet.”
A Mediterranean diet pattern (2:1 ratio) can yield a multitude of health benefits.

- Inclusion of healthier fats – oils, seeds and nuts – especially walnuts – is beneficial.

- Including more plant foods requires
  - Translation of the science to the consumer
  - Time to make change in dietary patterns
  - Tips to make it practical for patients and clients.
Practical Applications

- Nuts do not require cooking or preparation
- Nuts can be easily transported and apportioned
Breakfast Options

- Mix nuts, raisins and rolled oats for easy granola
- Add toasted nuts to cereal or yogurt
- Blend mashed bananas with nuts to make a filling for stuffed French toast
- Add walnut pesto to a vegetable omelet
- Add chopped nuts to pancake or waffle mix
Salads, Sandwiches and Snacks

- Add chopped nuts to salads for a healthy crunch
- Add chopped nuts to sandwich or wrap fillings
- Include a variety of nuts in trail mixes
- Nut butters with fresh apples and celery
Cheese Platters

- Add nuts to cheese platters with both mild and aged cheeses
- Combine blue cheese with toasted walnuts and honey
- Serve assorted artisan cheeses with dried figs and nut crisps
Entrees

- Use walnuts, apple pieces and brie cheese to top pizza

- Add toasted nuts to stir-fried or sautéed vegetables for added crunch, flavor and nutrients

- Mix ground nuts and breadcrumbs to encrust salmon fillets or chicken breasts

- Serve a creamy walnut sauce over fettuccini
Desserts

- Top cookie bars, squares or icings with nuts for a decorative finish

- Add chopped nuts to enhance the flavor and texture of muffins, cakes, cookies and breads

- Ground nuts can be added to pie crumb crusts
Thank You!