Mediterranean Diet and the Incidence of Stroke in the California Teachers Study

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Columbia University Medical Center, New York, NY
City of Hope, Duarte, CA
Mediterranean Diet

MONTHLY
- red meat

WEEKLY
- sweets
- eggs
- potatoes
- olives, pulses, nuts
- poultry
- fish

DAILY
- dairy products
- olive oil
- fruit
- vegetables (including wild greens)
- non-refined cereals and products (whole grain bread, whole grain pasta, brown rice, etc)
- wine in moderation

regular physical activity

COLUMBIA UNIVERSITY MEDICAL CENTER

City of Hope
Mediterranean Diet Score

• High Score
  • Fruits and vegetables
  • Monounsaturated fats (olive oil)
  • Whole grains
  • Legumes and nuts
  • Fish
  • Moderate alcohol

• Low Score
  • Meat
  • Refined and simple carbohydrates
  • Dairy
Hypothesis

• Higher adherence to the Mediterranean diet would be associated with reduced total, ischemic and hemorrhagic stroke incidence in the California Teacher Study cohort.
Methods

- In 1995, 133,479 female public school teachers and administrators were enrolled in the study.
- Geographically and socioeconomically diverse.
- Mail paper questionnaires every 4-5 years.
- Linked with California Cancer Registry.
Methods

- Linked with California hospitalization discharge database (inpatient, ER and ambulatory surgery)
- Stroke defined by ICD9 codes and diagnosis codes validated by a committee of neurologists
  - 3,165 strokes
  - 2,270 ischemic strokes
  - 895 hemorrhagic strokes
Methods: Dietary Assessment

• Diet assessed with validated Food Frequency Questionnaire (1995 Block, 103 items) using the baseline questionnaire (report diet in the past year)

• Based on a scoring system developed for a Greek population by Trichopolou et al.*

• Focuses on higher consumption of plant-based foods, including plant proteins, monounsaturated fat, and fish, and lower consumption of animal products and dairy

• A 10 point scale, 0-9, with higher score showing greater adherence

Methods: Statistical Analysis

- Multivariable Cox proportional-hazard models (hazard ratio, 95% CI)
- Adjusted for socio-demographic factors and disease variables
  - Age
  - Ethnicity
  - Socioeconomic status
  - Moderate-to-strenuous physical activity
  - Total calorie intake
  - Body mass index
  - Cigarette smoking
  - Menopausal and hormonal status
  - Disease variables (Hypertension, diabetes, hypercholesterolemia, atrial fibrillation, coronary heart disease/MI)
Results: Data Collection

133479 participants completed baseline assessment

123021 participants

122924 participants

121779 participants

113547 participants

Final 104268 eligible participants

10457 not living in CA at baseline excluded, 1 excluded per participant’s request in 2012

97 with stroke in OSHPD prior to baseline excluded

1145 <26 years and >99 years of age excluded

8232 excluded due to missing data on smoking, SES outside deciles, body mass index

9279 excluded due to missing diet variables
## Results: Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean ± SD)</td>
<td>52.9 ± 13.9</td>
</tr>
<tr>
<td>Kilocalories</td>
<td>1596 ± 558</td>
</tr>
<tr>
<td>Race, %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>White: 87.4</td>
</tr>
<tr>
<td></td>
<td>Black: 2.4</td>
</tr>
<tr>
<td></td>
<td>Hispanic: 4.1</td>
</tr>
<tr>
<td></td>
<td>Asians: 3.5</td>
</tr>
<tr>
<td></td>
<td>Others: 2.6</td>
</tr>
</tbody>
</table>
### Results: Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smoking</strong></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>66.1</td>
</tr>
<tr>
<td>Former</td>
<td>28.1</td>
</tr>
<tr>
<td>Current</td>
<td>5</td>
</tr>
<tr>
<td><strong>Body Mass Index</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;18.5</td>
<td>2.6</td>
</tr>
<tr>
<td>18.5-25</td>
<td>58.2</td>
</tr>
<tr>
<td>25-30</td>
<td>24.9</td>
</tr>
<tr>
<td>≥30</td>
<td>14.3</td>
</tr>
</tbody>
</table>
## Results: Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate recreational physical activity over the past three years, hours per week</td>
<td></td>
</tr>
<tr>
<td>0-0.5</td>
<td>32.7</td>
</tr>
<tr>
<td>0.51-2.50</td>
<td>31.2</td>
</tr>
<tr>
<td>2.51-4.50</td>
<td>14.5</td>
</tr>
<tr>
<td>4.51-7.0</td>
<td>14.2</td>
</tr>
<tr>
<td>≥7.01</td>
<td>7.4</td>
</tr>
</tbody>
</table>
# Results: Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>34.8</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7.3</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>22.8</td>
</tr>
<tr>
<td>CHD or MI</td>
<td>7.6</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>6.9</td>
</tr>
</tbody>
</table>
## Results: Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Menopause and hormone therapy</strong></td>
<td></td>
</tr>
<tr>
<td>Premenopausal</td>
<td>40.1</td>
</tr>
<tr>
<td>Peri/post-menopausal, no hormone therapy</td>
<td>12.1</td>
</tr>
<tr>
<td>Peri/post-menopausal, current or former hormone therapy</td>
<td>36.1</td>
</tr>
<tr>
<td>Peri/post-menopausal unknown hormone therapy</td>
<td>3.4</td>
</tr>
<tr>
<td>Unable to classify</td>
<td>8.3</td>
</tr>
</tbody>
</table>
Results: Baseline Characteristics

Population percentage adherent to Mediterranean diet by score (1 year)

- 0-2: 16.1%
- 3: 18.2%
- 4: 21.4%
- 5: 20.1%
- 6-9: 24.27%
Mediterranean Diet and all stroke incidence

Unadjusted Hazard Ratio

Mediterranean Diet Score groups (p trend <0.0001)
Mediterranean Diet and all stroke incidence

Adjusted Hazard Ratio*

- 0-2: 0.89
- 3: 0.89
- 4: 0.89
- 5: 0.86
- 6-9: 0.83

*Age, race, SES, moderate plus strenuous physical activity, kilocalories, BMI, smoking, hypertension, diabetes, atrial fibrillation, hypercholesterolemia, history of cardiac disease and menopausal status and hormone therapy.
Mediterranean Diet and ischemic stroke incidence

Unadjusted Hazard Ratio

Mediterranean Diet Score groups (p trend <0.0001)
Mediterranean Diet and ischemic stroke incidence

Adjusted Hazard Ratio*

Mediterranean Diet Score groups (p trend 0.01)

*Age, race, SES, moderate plus strenuous physical activity, kilocalories, BMI, smoking, hypertension, diabetes, atrial fibrillation, hypercholesterolemia, history of cardiac disease and menopausal status and hormone therapy.
Mediterranean Diet and hemorrhagic stroke incidence

Unadjusted Hazard Ratio

Mediterranean Diet Score groups (p trend 0.01)
Mediterranean Diet and hemorrhagic stroke incidence

Adjusted Hazard Ratio*

Mediterranean Diet Score groups (p trend 0.06)

*Age, race, SES, moderate plus strenuous physical activity, kilocalories, BMI, smoking, hypertension, diabetes, atrial fibrillation, hypercholesterolemia, history of cardiac disease and menopausal status and hormone therapy.
Summary

• Greater adherence to Mediterranean dietary pattern is associated with 10-18% decreased risk in total, and ischemic stroke incidence
• There was no significant association with hemorrhagic stroke

• Study strengths
  – Large cohort of women
  – Extensive detail on risk factors such as physical activity, hormonal status etc. over time
  – Statistical models adjusted for known clinical and behavioral risk factors

• Study limitations
  – Effects of individual diet components not explored
  – Study restricted to women, Californians, teachers
Study Team

City of Hope
• Sophia Wang, PhD
• Huiyan Ma, PhD
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• Leslie Bernstein, PhD

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Columbia University
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• Yian Gu, PhD
• Nikolaos Scarmeas, MD, MS
• Joshua Willey, MD, MS

Cedars Sinai
• Dean Sherzai, MD, MAS, PhD

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