Mediterranean Diet and Cardiovascular Risk for Firefighters

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Background – Mediterranean diet

- The Mediterranean diet is a modern nutritional recommendation inspired by the traditional dietary patterns of Greece and Southern Italy.
- The principal aspects of this diet include proportionally high consumption of olive oil, legumes, unrefined cereals, fruits, and vegetables, moderate to high consumption of fish, moderate consumption of dairy products (mostly as cheese and yogurt), moderate wine consumption, and low consumption of meat and meat products.
- UNESCO recognized this diet pattern as an Intangible Cultural Heritage of Italy, Greece, Spain and Morocco.
Background: characteristics of MD

- It is not a low-fat diet!!!
- Low in saturated fat
- High in monounsaturated fat
- High in dietary fiber
- Risk of high salt intake (e.g. olives, salt-cured cheeses, anchovies, capers)
- Red wine: flavonoids with powerful antioxidant properties
- Low in animal protein
- Potentially a sustainable diet in many countries

Background: potential health effect of MD

- ↓ death rates from heart disease
- ↓ risk of a second cardiovascular event
- ↓ of type 2 diabetes
- ↓ metabolic syndrome
- ↑ weight loss
- ↓ cancer mortality
- ↓ Parkinson's and Alzheimer's disease

High risk of bias due to lifestyles, behaviors and genetic

RCT has shown a protective effect on CVD (N Engl J Med 2013;368:1279-90)
Aim

- Little is known about the effects of Mediterranean-style diet among young working groups in non-Mediterranean countries.
- To the best of our knowledge, no studies have examined this dietary pattern in a North American occupational cohort.
- We investigated a modified Mediterranean diet score to assess Mediterranean diet adherence and its associations in a population of United States Midwestern firefighters.

Methods – Study population

- Cross-sectional study of career firefighters from 11 fire departments of two Midwestern states.
- Life-style questionnaire to measure adherence to a Mediterranean-like diet.
- CVD biomarkers measured during baseline medical evaluation.
- Inclusion criteria:
  - completion of a and fire department-sponsored medical examination including a maximal exercise.
  - completion of the life-style questionnaire.
  - absence of work-restrictions at examination.
  - signed informed consent.
Methods – Mediterranean-like diet

- Pre-existing life-style questionnaire
- Modified Mediterranean diet score (mMDS) based on Mediterranean diet components and adherence to traditional Mediterranean eating patterns
- Scoring system based on 15 question (10 food domains)
- For each question a 4-point scale was developed (4 is given to the response that best represents a Mediterranean-style diet)
- If appropriate, different questions meals at the workplace and at home
- The total mMDS score has a possible range of 0 (no conformity to a Mediterranean-style diet) to 42 (72 maximal conformity to a Mediterranean-style diet based on our scoring system).

Methods: Food domains
Methods: CVD risk factors and covariates (I)

- BMI was recorded from measured height and weight
- Body fat (%), estimated by BIA with skin fold measures, was added to the medical evaluation protocol while the study was in progress.
- Cardio-respiratory fitness was measured using symptom-limited maximal treadmill exercise testing with estimation of oxygen consumption (metabolic equivalents [METS]) according to the Bruce protocol.
- Criteria for metabolic syndrome:
  - abdominal obesity- modified here to BMI ≥30;
  - hypertriglyceridemia (≥150 mg/dL);
  - reduced HDL-chol <40 mg/dL;
  - elevated BP (SBP ≥130; DBP ≥85 mmHg) and/or antihypertensive drug treatment;
  - hyperglycemia (blood glucose ≥100 mg/dL).

Methods: CVD risk factors and covariates (II)

- Resting pulse and blood pressure were obtained from the physical examination.
- Fasting venous blood samples: total chol, HDL-chol, LDL-chol, and glucose
- Weight change assesses by asking: “In the last 5 years, my body weight has gone...”. Possible answers included:
  - down a lot (>10 pounds);
  - down a little (5–10 pounds);
  - not changed (< 5 90 pounds);
  - up a little (5–10 pounds); and up a lot (>10 pounds).
- Weekly physical activity was estimated from average reported exercise frequency and the average reported duration of aerobic/cardio sessions each week. The product of these two responses yielded the average duration of total weekly aerobic exercise expressed in minutes.
Methods: statistical analysis

- Trends across ordered groups: Cuzick nonparametric test
- Linear regression models to study the effect of a unitary increase in mMDS
- Right-skewed variables were log-transformed
- Ordered logistic regression models to study naturally ordered variables
- Parallel regression assumption was tested via the Brant test
- A P value < 0.05 (two-sided) was considered statistically significant
- Statistical analyses were carried out using Stata 12.1 SE

Results: distribution of mMDS

![Distribution of the Modified Mediterranean Diet Score](image)
**Results: mMDS – single-item scores**

<table>
<thead>
<tr>
<th>Single item scores, mean (SD)</th>
<th>Normal weight (N=108)</th>
<th>Overweight (N=401)</th>
<th>Obese, class I (N=203)</th>
<th>Obese, class II (N=85)</th>
<th>P trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>eating fast-food or take-out food servings of fruit or vegetables</td>
<td>2.8 (1.2)</td>
<td>2.7 (1.1)</td>
<td>2.6 (1.1)</td>
<td>2.3 (1.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>eating sweet desserts</td>
<td>2.6 (1.2)</td>
<td>2.7 (1.2)</td>
<td>2.8 (1.1)</td>
<td>2.8 (1.2)</td>
<td>0.389*</td>
</tr>
<tr>
<td>oil or fat most used at home</td>
<td>2.2 (1.6)</td>
<td>2.6 (1.5)</td>
<td>2.4 (1.5)</td>
<td>2.6 (1.6)</td>
<td>0.391</td>
</tr>
</tbody>
</table>

**Most weeks I eat baked, boiled, grilled or blackened (not fried) ocean fish**

<table>
<thead>
<tr>
<th>2nd</th>
<th>1 or less</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>4</th>
<th>P trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>breads or starches most eaten at home</td>
<td>46</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.047</td>
</tr>
<tr>
<td>breads or starches most eaten at the firehouse</td>
<td>1.7 (1.7)</td>
<td>1.5 (1.7)</td>
<td>1.8 (1.8)</td>
<td>1.8 (1.8)</td>
<td>0.358</td>
<td></td>
</tr>
<tr>
<td>eating ocean fish</td>
<td>1.6 (0.9)</td>
<td>1.5 (0.7)</td>
<td>1.5 (0.8)</td>
<td>1.5 (0.7)</td>
<td>0.829</td>
<td></td>
</tr>
<tr>
<td>drink taken with meals at home</td>
<td>2.9 (1.6)</td>
<td>2.6 (1.7)</td>
<td>2.3 (1.7)</td>
<td>2.1 (1.7)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>drink taken with meals at the firehouse</td>
<td>2.7 (1.7)</td>
<td>2.6 (1.7)</td>
<td>2.5 (1.6)</td>
<td>1.9 (1.8)</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>quantity of alcoholic beverages</td>
<td>2.1 (1.6)</td>
<td>2.1 (1.5)</td>
<td>2.0 (1.5)</td>
<td>1.8 (1.6)</td>
<td>0.093</td>
<td></td>
</tr>
<tr>
<td>drinking wine, mean (SD)</td>
<td>0.1 (0.4)</td>
<td>0.1 (0.5)</td>
<td>0.2 (0.5)</td>
<td>0.1 (0.5)</td>
<td>0.667</td>
<td></td>
</tr>
<tr>
<td>Total Mediterranean diet score</td>
<td>21.7 (5.5)</td>
<td>21.6 (5.4)</td>
<td>21.0 (5.7)</td>
<td>19.8 (5.6)</td>
<td>0.008</td>
<td></td>
</tr>
</tbody>
</table>

**Results: mMDS and CVD risk factors**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Adjusted by age and BMI</th>
<th>Adjusted by age, BMI and physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>780</td>
<td>37.7 (6.8)</td>
<td>-0.077 -0.2% 0.164 -0.080 -0.2% 0.172</td>
<td></td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>780</td>
<td>29.3 (4.4)</td>
<td>-0.051 -0.2% 0.093</td>
<td></td>
</tr>
<tr>
<td>Body fat, %</td>
<td>233</td>
<td>23.6 (6.6)</td>
<td>-0.075 -0.3% 0.121 -0.042 -0.2% 0.404</td>
<td></td>
</tr>
<tr>
<td>Resting systolic BP, mmHg</td>
<td>780</td>
<td>122 (13)</td>
<td>0.113 +0.1% 0.156 0.055 0.0% 0.515</td>
<td></td>
</tr>
<tr>
<td>Resting diastolic BP, mmHg</td>
<td>780</td>
<td>80.0 (8.1)</td>
<td>0.008 0.0% 0.874 0.007 0.0% 0.899</td>
<td></td>
</tr>
<tr>
<td>Resting HR, bpm</td>
<td>780</td>
<td>69.4 (11.5)</td>
<td>-0.200 -0.3% 0.006 -0.107 -0.2% 0.157</td>
<td></td>
</tr>
<tr>
<td>METS</td>
<td>766</td>
<td>12.7 (1.1)</td>
<td>0.003a +0.3% &lt;0.001 0.002a +0.2% 0.028</td>
<td></td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>780</td>
<td>125.1 (1.8)</td>
<td>-0.010a -1.0% 0.005 -0.005a -0.5% 0.189</td>
<td></td>
</tr>
<tr>
<td>Total cholesterol, mg/dL</td>
<td>780</td>
<td>191.1 (1.2)</td>
<td>-0.003a -0.3% 0.014 -0.003a -0.3% 0.055</td>
<td></td>
</tr>
<tr>
<td>LDL-cholesterol, mg/dL</td>
<td>759</td>
<td>115.6 (1.4)</td>
<td>-0.005a -0.5% 0.018 -0.004a -0.4% 0.040</td>
<td></td>
</tr>
<tr>
<td>HDL-cholesterol, mg/dL</td>
<td>780</td>
<td>44.1 (1.3)</td>
<td>0.006a +0.6% &lt;0.001 0.004a +0.4% 0.008</td>
<td></td>
</tr>
<tr>
<td>Total cholesterol/HDL</td>
<td>780</td>
<td>4.3 (1.4)</td>
<td>-0.009a -0.9% &lt;0.001 -0.007a -0.7% 0.001</td>
<td></td>
</tr>
<tr>
<td>Blood sugar, mg/dL</td>
<td>780</td>
<td>92.4 (1.2)</td>
<td>0.0000 0.0% 0.926 0.0000 0.0% 0.672</td>
<td></td>
</tr>
</tbody>
</table>

*Linear regression model conducted on a log-transformed dependent variable.
Results: mMDS and metabolic syndrome

<table>
<thead>
<tr>
<th>Mediterranean diet score</th>
<th>Metabolic syndrome score</th>
<th>Estimates adjusted by age</th>
<th>Estimates adjusted by age and physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I quartile</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>II quartile</td>
<td>46 (23.6)</td>
<td>52 (26.7)</td>
<td>41 (21.0)</td>
</tr>
<tr>
<td>III quartile</td>
<td>44 (23.2)</td>
<td>50 (26.3)</td>
<td>41 (21.6)</td>
</tr>
<tr>
<td>IV quartile</td>
<td>59 (29.4)</td>
<td>59 (29.4)</td>
<td>32 (15.9)</td>
</tr>
</tbody>
</table>

P trend: 0.001

Results: mMDS and weight change

<table>
<thead>
<tr>
<th>Mediterranean diet score</th>
<th>Self-reported body weight change in the last 5 years</th>
<th>Estimates adjusted by age and BMI</th>
<th>Estimates adjusted by age, BMI and physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Down &gt;10 lbs.</td>
<td>Down 5-10 lbs.</td>
<td>Stable</td>
</tr>
<tr>
<td>I quartile</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>II quartile</td>
<td>15 (7.9)</td>
<td>16 (8.5)</td>
<td>66 (34.9)</td>
</tr>
<tr>
<td>III quartile</td>
<td>12 (6.4)</td>
<td>31 (16.4)</td>
<td>53 (28.0)</td>
</tr>
<tr>
<td>IV quartile</td>
<td>31 (15.5)</td>
<td>20 (10.0)</td>
<td>78 (39.0)</td>
</tr>
</tbody>
</table>

P trend: <0.001
Discussion: main findings

- Beneficial associations between higher mMDS and CVD risk factors among a young and occupationally active North American cohort.
- Subjects who were obese had a significantly lower mMDS score. This difference was primarily because obese participants were more inclined to have sweetened drinks or beverages with less nutritional value during meals, and they were more likely to consume fast/take-out foods.
- We observed higher HDL-c and lower LDL-c in those with better mMDS.
- Metabolic syndrome score was inversely associated with Mediterranean-style diet in our study.
- We also observed a consistent beneficial trend in reported weight gain over the past 5 years among those with lower mMDS.

Discussion: beverages

- Our study revealed interesting findings regarding beverage consumption.
- The intake of sweetened beverages are well known to be correlated with obesity and increased cardiovascular risk. Sugary drinks are considered the greatest contributor to added-sugar intake in the U.S.
- We believe sweetened beverage consumption is an important dietary determinant and should be incorporated into the Mediterranean diet scoring systems.
- Contrary to patterns observed in traditional Mediterranean countries, we observed very low wine consumption. This was likely the result of socio-cultural preferences as 60% of participants reported beer as their drink-of-choice. Educating existing drinkers in similar group of workers on avoiding alcoholic beverages lacking important antioxidant properties might be an area of interest.
Discussion: limitations

- Life-style questionnaire was originally designed to obtain general dietary information, rather than assess a specific diet pattern.
- Information on total energy intake and certain traditional Mediterranean food domains (e.g. nuts and legumes) were not collected and accounted for in the analyses.
- We were limited in our ability to assess the associations of ocean fish consumption by the very low consumption observed in our cohort likely due to its geographic setting in U.S. Midwest.
- Only a small proportion of our study population were regular wine drinkers. Thus, we had limited statistical power to study the possible beneficial effects of moderate wine consumption.

Conclusions

- In a cohort of young working North American male adults, metabolic syndrome score, LDL-cholesterol and reported weight gain had significant inverse associations with increasing mMDS, while higher HDL-cholesterol was found to be significantly and independently associated with higher mMDS.
- The observed relationships support the potential effectiveness of a Mediterranean-style diet in younger, working cohorts in non-Mediterranean countries, and justify future intervention studies.
References