Dietary influence on response to PM: Asthma and COPD

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Disclosures

(1) The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

- Boehringer Ingelheim (Advisory Board)
- Mylan Theravance (Advisory Board)
- Astra Zeneca (grant support)
- Austin Air for donation of air cleaners

(2) The following personal financial relationships with tobacco industry entities existed during the past 12 months:

None
Exposome: Many Factors Coalesce to affect respiratory health

- Obesity
- Psycho-social stress
- Asthma
- COPD
- Indoor and outdoor air pollution
- Food
- Obesity
- Allergen
- Smoking
- Genetics
- Education
- Health Care Access
- Poverty
- Psychosocial stress
Sources of Indoor Pollution

Hansel et al. EHP 2009
McCormack et al EHP 2009
Paulin et al. J of Env Protection. 2013
Paulin et al. Env Research 2017
Low SES and pollutant burden in US Homes: PM levels in inner city Baltimore

Simons et al. 2007
McCormack et al. EHP. 2009
Indoor PM and Asthma Morbidity

*Adjusted for age, gender, race, socioeconomic status

IRR per 10 µg/m³ increase in PM
• Non-smoking homes. Indoor PM was relatively low
  – ~11 ug/m³
• Indoor \( \text{PM}_{2.5} \) was associated with increases in
  – Severe COPD exacerbations
  – Respiratory Symptoms (MMRC)
  – Respiratory Health Status (SGRQ)
  – Rescue Medication use
Omega-3 and 6 polyunsaturated fatty acids

- Omega-3 fatty acid
  1. α-linolenic acid (ALA) (found in plant oils)
  2. Eicosapentaenoic acid (EPA), (found in marine oils)
  3. Docosahexaenoic acid (DHA), (found in marine oils)

- Omega-6 fatty acid:
  Necessary for human health, but too much associated with disease
    a. Coronary heart disease and stroke
    b. Autoimmune disorders
    c. Cancers of the breast, colon, and prostate etc.

- Balanced omega-3 and omega-6 fatty acids diet
Dietary intake of Omega 3 and 6 PUFAs in Baltimore inner city children with asthma

Omega 3
Recommended intake >0.9g
Age 4-8 yrs

Omega 6:3

(Diet Study, N = 137, R = 541)

(Diet Study, N = 136, R = 339)
Omega-6 intake linked with increased risk of severe asthma

Brigham et al AJRCCM.2019
Omega fatty acid intake modifies susceptibility to PM in kids with asthma

A. 

B. 

Brigham et al AJRCCM.2019
Omega intake in NHANES 2007-2012 COPD population

Association between PUFAs and COPD controversial

Fulton et al. Nutrition Reviews. 2015

NHANES 2007-2012
• Age >40 years
• >100 cigs
• FEV$_1$/FVC < 0.7
• No asthma diagnosis
• N=878 of 27,528

Table 1 Characteristics of U.S. Adults with COPD, NHANES 2007–2012

<table>
<thead>
<tr>
<th>Demographics</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60.6 ± 8.4</td>
</tr>
<tr>
<td>Male (%)</td>
<td>63.5</td>
</tr>
<tr>
<td>Ethnicity (%)</td>
<td></td>
</tr>
<tr>
<td>Non-hispanic White</td>
<td>85.1</td>
</tr>
<tr>
<td>Others</td>
<td>14.8</td>
</tr>
<tr>
<td>Pack-Years</td>
<td>30.4 ± 23.8</td>
</tr>
<tr>
<td>BMI, kg/m2</td>
<td>27.3 ± 4.9</td>
</tr>
</tbody>
</table>

Dietary Intake

| Energy (kcal)                 | 2112 ± 680 |
| Omega-3                       |       |
| EPA + DHA (g)                 | 0.11 ± 0.21 |
| ALA (g)                       | 1.71 ± 0.89 |
Beneficial effect of EPA + DHA intake on respiratory symptoms among current smokers with low education

Lemoine et al. BMC Pulm. In press
Dietary intake of Omega 3 and 6 PUFAs in adults with COPD

Omega-3

Recommended intake: >0.25 g/day

Omega-6

Recommended intake: 11-13 g/day (women)
15-16 g/day (men)
<table>
<thead>
<tr>
<th>Omega-3 (EPA + DHA)</th>
<th>( \beta )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV(_1) % Predicted</td>
<td>0.31</td>
<td>0.66</td>
</tr>
<tr>
<td>mMRC (OR)</td>
<td>0.80</td>
<td>0.03</td>
</tr>
<tr>
<td>CAT</td>
<td>-0.96</td>
<td>0.00</td>
</tr>
<tr>
<td>SGRQ</td>
<td>-1.88</td>
<td>0.01</td>
</tr>
<tr>
<td>CCQ</td>
<td>-0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>6MWD</td>
<td>64.27</td>
<td>0.00</td>
</tr>
<tr>
<td>ECSS</td>
<td>-0.26</td>
<td>0.08</td>
</tr>
<tr>
<td>Exacerbations (OR)</td>
<td>0.90</td>
<td>0.38</td>
</tr>
<tr>
<td>ED visit/Hosp (OR)</td>
<td>0.86</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Adjusted for age, gender, race (white vs. others), education (high school or less vs. more than high school), BMI, total calories, pack-years, FEV\(_1\) % predicted (except when FE\(_1\) % predicted is the outcome), omega 6 (ARA). Results represent 0.1g increase in omega-3.
**PM$_{2.5}$ effect accentuated with low omega-3 in COPD**

<table>
<thead>
<tr>
<th></th>
<th>Low Omega-3</th>
<th>High Omega-3</th>
<th>Interact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$p$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>mMRC</td>
<td>0.43</td>
<td>0.002</td>
<td>-0.10</td>
</tr>
<tr>
<td>Clinical COPD Q (CCQ)</td>
<td>0.46</td>
<td>0.004</td>
<td>0.05</td>
</tr>
<tr>
<td>FEV1 Post Pct Pred</td>
<td>-3.14</td>
<td>0.175</td>
<td>1.14</td>
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</tbody>
</table>

Model adjusted by race, education, BMI, calories, and packyears, n=77

![Graph showing average marginal effects of PM$_{2.5}$ on clinical COPD questionnaire (CCQ) with 95% CI](image)
Fish oil attenuates PM-induced airway and systemic inflammation in rat lungs

Li et al. Respiratory Research. 2019
Conclusions

• PUFA intake may have direct associations with airway disease outcomes, however, relationship may need to be taken in context of other exposures

• Omega 3 intake (EPA + DHA) may be protective against the adverse effects of particulate exposure on both asthma and COPD outcomes
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