Associations among Organochlorine Pesticides, Methanobacterales, and Obesity in Korean Women

Hae-Sook Lee¹, Je-Chul Lee², In-Kyu Lee³, Hyo-Bang Moon⁴, Yoon-Seok Chang⁵, David R. Jacobs, Jr.⁶,⁷, Duk-Hee Lee⁸*

David Jacobs, PhD
Mayo Professor of Public Health
University of Minnesota
Collaborative on Health and the Environment
January 19, 2012

Acknowledgement: Title, Table 1 and Figure are exact copies from the published PLOS One article, November 2011 | Volume 6 | Issue 11 | e27773
Origin of Idea

- This research was the idea of Duk-Hee Lee.
- While searching for ways to reduce body burden of POPs, she learned that some microorganisms increase biodegradation of POPs in the environment.
- She considered that a similar thing might happen in the gut and performed a small study to test this.
Background

- Methanogens are microbes that produce methane gas from various substrates such as H₂ and CO₂, acetate, and methylamine.
- They were identified as belonging to the domain archaea in the 1970s.
- Removal of H₂ by methanogens could promote obesity by improving fermentation efficiency of dietary polysaccharides.
- Methanogens reportedly biodegrade petroleum hydrocarbons in polluted environments and increase in the presence of petroleum contamination and are used to remove petroleum-based pollutants in environments.
- Therefore, we hypothesized that increased body burden of petroleum-based man-made chemicals such as OCPs would promote methanogens in human gut, which in turn would promote adiposity. OCPs are persistent organic pollutants (POPS).
Study Design

• 83 Korean women, community health service center routine health checkup

• Quantitative real-time PCR (qPCR) quantify Methanobacteriales in feces.

• Nine OCPs were measured in both serum and feces of 16 women.
Table 1. General characteristics by presence of *Methanobacteriales* (n = 83).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Present (n = 27)</th>
<th>Absent (n = 56)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean ± standard deviation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>58.6 ± 7.3</td>
<td>59.3 ± 7.8</td>
<td>0.71</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>26.4 ± 3.2</td>
<td>24.7 ± 3.5</td>
<td>0.04</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>88.8 ± 7.3</td>
<td>83.6 ± 9.0</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Percentages (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index ≥25 kg/m²</td>
<td>66.7%</td>
<td>46.4%</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Findings

- **Methanobacteriaales detected:**
  32.5% (27/83 women)

- **Methanobacteriaales and adiposity:**
  Levels in feces correlated with BMI and waist circumference
  \( r = +0.23 \) and \( P=0.03 \) for both.

- **Methanobacteriaales and serum OCPs (body burden):**
  Methanobacteriaales correlated with most serum OCPs
  - cis-nonachlor \( r = +0.53, P=0.05 \)
  - oxychlordane \( r = +0.46, P=0.1 \)
  - trans-nonachlor \( r = +0.43, P=0.1 \)

- **Methanobacteriaales generally uncorrelated with feces OCPs**
Figure 2. Scatter plot between serum concentrations of mixture of organochlorine pesticides belonging to Chlordane (oxychlordane, trans-Nonachlor, cis-Nonachlor, Heptachlor epoxide) and number of Methanobacteriaales (n = 16). When one subject with the highest number of Methanobacteriaales ($38.7 \times 10^7$) was excluded, the correlation coefficient was 0.45 ($p = 0.09$).

doi:10.1371/journal.pone.0027773.g002
Conclusions

The results are consistent with our hypotheses that body burden of OCPs may determine the levels of Methanobacteriales in the human gut, and that this process can finally lead to increased body weight and waist circumference.