Exposure to the Pesticide Chlordane is Associated with Increased Risk of Metabolic Syndrome

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Outline

• What is Metabolic Syndrome?
  o Characteristics
  o Prevalence

• What is Chlordane?
  o Uses
  o Mechanism of Action

• My Research
  o NHANES
  o Methods
  o Results
  o Implications
Metabolic Syndrome Characteristics

- Three or more of the following:
  - Elevated Waist Circumference
    - In men: >102 cm
    - In women: >88 cm
  - Hypertriglyceridemia
    - ≥150 mg/dL
  - Low HDL-Cholesterol
    - In men: <40 mg/dL
    - In women: <50 mg/dL
  - High Blood Pressure
    - ≥130/85 mmHg
  - Elevated Fasting Blood Glucose
    - ≥100 mg/dL
Metabolic Syndrome Prevalence

- Age-adjusted Rates in 1988 – 1994:
  - N = 6,423
    - Overall: 29.2%
    - Men: 31.4%
    - Women: 27.1%

- Age-adjusted Rates in 1999 – 2006:
  - N = 6,962
    - Overall: 34.2%
    - Men: 34.9%
    - Women: 33.3%

- Significant increase in prevalence

(Mozumdar, A., & Liguori, G., 2011)
Metabolic Syndrome
Risk Factors

• Age
• Race
• Obesity
• History of diabetes

• Environmental factors?

(Mayo Clinic, 2013)
Chlordane

- Used in United States from 1948 – 1988
  - Pesticide on crops, lawns, gardens & in buildings
  - Termites & fire ant control
- Persistent organic pollutant in environment
  - Fastens powerfully to the soil
  - Can stay in soil for >20 years due to slow breakdown
  - Builds up & stored in animal products in our food supply
  - Exposure: food & air in treated homes

(National Pesticide Information Center, 2001)
(Agency for Toxic Substances & Disease Registry, 1995)
Chlordane

• In the body:
  o Chlordane is transformed into variety of metabolites
  o Oxychlordane is the most common
  o Stored in our fat tissue

• Mechanism of Action:
  o Damage mitochondria in liver & muscle
    • Important organelle in metabolism
  o Impacts expression of genes that create proteins important in triglyceride & cholesterol synthesis

(Ruzzin J, Petersen R, Frøyland L, et al., 2010)
Research on Chlordane

• Previous epidemiological research has identified an association between chlordane & negative health impacts
  o Higher risk of Type 2 Diabetes
  o Increased BMI in men
    • (Elobeid, M., Padilla, M., Brock, D., Ruden, D., & Allison, D., 2010)
  o Hypertriglyceridemia
    • (Lee, D., Lee, I., Porta, M., Steffes, M., & Jacobs, D., 2007)
My Research
NHANES

- CDC’s National Health And Nutrition Examination Survey
  - Assesses the health & nutritional status of adults & children in the U.S.
  - About 10,000 people every 2 yrs
  - Nationally representative
- Includes an interview, physical exam & a lab component
  - Examples: blood pressure, diet behavior, balance, acculturation, mental health assessments, blood albumin & much more
Methods

• Utilized data from 1999 – 2004 (N=31,126)
• Sampled non-pregnant, non-lactating & fasted adults ≥20 years old
  o N = 3465
• Utilized statistical analysis software SAS 9.2
• Log transformed oxychlordane data
• Used logistic regression
• All results are:
  o Adjusted for age, gender & ethnicity
  o Odds Ratio Estimates with Walden 95% Confidence Intervals
My Results

...
## Sample Characteristics

### Descriptive Characteristics of Adults ≥20 years old, NHANES, 1999-2004 (n=3465)

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Mean ± SE</th>
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</thead>
<tbody>
<tr>
<td>Oxychlordane, lipid-adjusted</td>
<td>18.03 ±17.43</td>
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<tr>
<td>Age (years)</td>
<td>46.57 ± 16.80</td>
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<tr>
<td><strong>Gender</strong></td>
<td><strong>Frequency, %</strong></td>
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<tr>
<td>Women</td>
<td>50.67</td>
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<tr>
<td><strong>Ethnicity</strong></td>
<td><strong>Frequency, %</strong></td>
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<tr>
<td>NH White</td>
<td>72.84</td>
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<tr>
<td>NH Black</td>
<td>9.98</td>
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<tr>
<td>Mexican American</td>
<td>7.41</td>
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<tr>
<td>Other Race/Ethnicity</td>
<td>9.77</td>
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### Metabolic Syndrome Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Mean ± SE</th>
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<tr>
<td>Diastolic Blood Pressure</td>
<td>71.94 ± 13.10</td>
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<tr>
<td>Systolic Blood Pressure</td>
<td>123.84 ± 19.24</td>
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<td>HDL Cholesterol</td>
<td>52.03 ± 15.43</td>
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<td>Fasting Glucose</td>
<td>101.86 ± 29.83</td>
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<td>Triglyceride</td>
<td>153.12 ± 125.37</td>
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<tr>
<td>Waist Circumference</td>
<td>96.44 ± 15.64</td>
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</table>
The Effect of Plasma Oxychlorodane Concentration on Metabolic Syndrome Risk

Odds Ratio

Plasma Oxychlorodane Quartile

< 25th pct
25-50th pct
50-75th pct
> 75th pct
Plasma Oxychlordane Quartile and Abdominal Obesity & Hypertriglyceride Risk

Odds Ratio

- Hypertriglyceridemia
  - > 75th pct
  - 50-75th pct
  - 25-50th pct
  - < 25th pct

- Abdominal Obesity
  - > 75th pct
  - 50-75th pct
  - 25-50th pct
  - < 25th pct
Plasma Oxychlordane Quartiles and Hyperglycemia, High BP, & Low HDL-C

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<thead>
<tr>
<th></th>
<th>&lt; 25th pct</th>
<th>25-50th pct</th>
<th>50-75th pct</th>
<th>&gt; 75th pct</th>
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<tr>
<td>High BP</td>
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<td>Hyperglycemia</td>
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<tr>
<td>Low HDL-C</td>
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Odds Ratio
Implications

• Elevated blood levels of oxychlordane is associated with:
  o Metabolic syndrome
  o Hypertriglyceridemia
  o Hyperglycemia
  o Elevated waist circumference
  o High blood pressure

• Although chlordane has not been commercially available since 1988, it persists in our environment & in the food Americans consume

• In addition to lifestyle factors, risk of chronic disease is influenced by environmental factors

• This is only one of many pesticides that the U.S. has & is currently using. What other health impacts do these chemicals have?
References

Thank you for your attention.

Questions & Comments?