Environmental Tobacco Smoke in the Residential Environment

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Tobacco Smoke

- Group A carcinogen
- Over 4000 chemicals
- 43 carcinogens including:
  - benzene
  - chromium
  - cadmium
  - polonium-210
  - formaldehyde
Prenatal Exposure

- 44% of female smokers continue to smoke during pregnancy

(Kahn, 2002)
ETS Exposure in the Home

- 43% of US children are exposed to ETS in their own homes by report
- 85% of children have measurable cotinine levels

(Pirkle, 1996)
Cotinine Levels by Exposure Source

Jordaan, 1999
Tobacco Smoke Links to Child Health

- Prematurity
- Low Apgars
- Poor growth
- Ear infection
- Hearing loss
- Colic
- SIDS
- Respiratory illness
- Asthma exacerbation
- Atopy

- $4.6 billion annually in health care costs
Tobacco Smoke Links to Child Development

General Developmental Delays and specific deficits in the following areas:

- Intelligence
- Reasoning
- Achievement
- Perceptual skills
- Reading
- Language
- Verbal comprehension
Prenatal Tobacco Smoke Exposure and IQ at 9-12 years

Fried, 1998
Tobacco Smoke Exposure and Adjusted Reasoning Scores at Age 5

Mean Raven Scores

- None: 9.8
- Prenatal: 11.3
- Postnatal: 10.8

Eskenazi, 1995
NHANES III
1988-1994

• 4399 children aged 6-16
• Denied tobacco use in past 5 days
• Serum cotinine levels $\leq$ 15 ng/ml
  • Non smokers
  • ETS exposure

Yolton, et al, in progress
NHANES III
1988-1994

• Cognitive testing
  • Math \hspace{1cm} \text{mean}=100, \text{SD}=15
  • Reading \hspace{1cm} \text{mean}=100, \text{SD}=15
  • Block design \hspace{1cm} \text{mean}=10, \text{SD}=3
  • Digit Span \hspace{1cm} \text{mean}=10, \text{SD}=3

• Controls for potential covariates
  Gender \hspace{1cm} Region \hspace{1cm} Race/Ethnicity
  Marital Status \hspace{1cm} Poverty \hspace{1cm} Parent Education
  Lead \hspace{1cm} Ferritin
Mean Math and Reading Scores in 6-16 Year Olds by Cotinine Quintiles

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## Adjusted Estimates of Cognitive Scores at Serum Cotinine ≤15 ng/ml

<table>
<thead>
<tr>
<th>Test</th>
<th>Adjusted Estimate (SE)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>-1.07 (.33)</td>
<td>.002</td>
</tr>
<tr>
<td>Math</td>
<td>-.76 (.30)</td>
<td>.01</td>
</tr>
<tr>
<td>Block Design</td>
<td>-.23 (.05)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Digit Span</td>
<td>-.05 (.06)</td>
<td>.36</td>
</tr>
</tbody>
</table>

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## Adjusted Estimates of Reading Score Change for 1 ng/ml Increase in Cotinine

<table>
<thead>
<tr>
<th>Reading</th>
<th>No.</th>
<th>Adjusted estimate</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤15 ng/ml</td>
<td>4399</td>
<td>-1.07 (.33)</td>
<td>.002</td>
</tr>
<tr>
<td>&lt;10 ng/ml</td>
<td>4391</td>
<td>-1.23 (.41)</td>
<td>.004</td>
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<tr>
<td>&lt;5 ng/ml</td>
<td>4336</td>
<td>-1.43 (.50)</td>
<td>.01</td>
</tr>
<tr>
<td>&lt;1 ng/ml</td>
<td>3502</td>
<td>-4.98 (1.75)</td>
<td>.01</td>
</tr>
<tr>
<td>&lt;0.5 ng/ml</td>
<td>2914</td>
<td>-11.84 (3.97)</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>6-16 yrs</td>
<td>6-11 yrs w/prenatal variables</td>
<td>6-11 yrs w/prenatal smoking</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>-------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>SE (p)</strong></td>
<td>SE (p)</td>
<td>SE (p)</td>
<td>SE (p)</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td>-1.07 (.002)</td>
<td>-.87 (.045)</td>
<td>-.87 (.03)</td>
</tr>
<tr>
<td><strong>Math</strong></td>
<td>-.76 (.01)</td>
<td>-.16 (.71)</td>
<td>-.27 (.51)</td>
</tr>
<tr>
<td><strong>Block Design</strong></td>
<td>-.23 (&lt;.001)</td>
<td>-.16 (.02)</td>
<td>-.18 (.02)</td>
</tr>
</tbody>
</table>
Tobacco Smoke Links to Child Behavior

- Impulsivity
- Risk taking
- Conduct disorder
- Rebelliousness
- Negativity
- Attention deficits
- Externalizing
Prenatal Exposure and Behavior at Age 12

Conduct

Attention

Disruptive

# Cigarettes

None

Low

High

p < .001

Fergusson, 1993
Adjusted Estimated RR of Child Behavior Problems by Tobacco Smoke Exposure

Williams, 1998
Evidence of Detrimental Effects of Tobacco Smoke

• Health consequences
• Developmental delays
• Behavior problems

• Prenatal exposure - clear evidence
• Postnatal ETS exposure - inconclusive
### Research Needs: Importance

Estimated Number of US Children 6-16 Yrs Exposed to Damaging Levels of ETS

<table>
<thead>
<tr>
<th>Cotinine Level</th>
<th>Percent</th>
<th>No. Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 15 ng/ml</td>
<td>5%</td>
<td>1.9 million</td>
</tr>
<tr>
<td>≥ 10 ng/ml</td>
<td>6%</td>
<td>2.0 million</td>
</tr>
<tr>
<td>≥ 5 ng/ml</td>
<td>8%</td>
<td>2.7 million</td>
</tr>
<tr>
<td>≥ 1 ng/ml</td>
<td>26%</td>
<td>9.0 million</td>
</tr>
<tr>
<td>≥ 0.5 ng/mL</td>
<td>38%</td>
<td>13.3 million</td>
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</tbody>
</table>

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Research Needs: Methodologies

• Use of biomarkers of exposure

• Large studies to separate prenatal and postnatal exposure effects

• Consistent measures of child outcome
Research Needs:
Topics

• More studies focused on ETS effects on child development and behavior

• Exploration into how ETS interacts with other prevalent toxicants

• Discovery of mechanisms by which ETS exerts its effects
Research Needs: Topics (continued)

- Further exploration into the impact of ETS exposure during pregnancy
- Development of novel intervention strategies to protect children from ETS exposure