INDOOR AIR POLLUTION AND COGNITIVE FUNCTION AMONG OLDER MEXICAN ADULTS

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Air pollution and cognitive function

- Growing evidence that exposure to high levels of air pollution can negatively affect cognition (Calderón et al., 2002; Weuve et al., 2012; Oudin et al., 2016).
- The majority of studies of air pollution and health have focused on outdoor air pollution.
- Fewer studies have investigated the cognitive effects of exposure to sources of air pollution inside the home.
What is indoor air pollution?

• Air pollution resulting from the indoor combustion of biomass for domestic energy (cooking, heating, lighting).
• Approximately half of the world uses solid fuels for cooking.
  • Up to 90% of rural households in developing countries.
• When these materials are burned inside with poor ventilation, exposure to particulate matter can far exceed the World Health Organization standards (Bruce, 2000).

Indoor Air Pollution


Indoor air pollution and health

• Previous work has suggested associations between exposure to indoor air pollution and:
  • Chronic obstructive pulmonary disease
  • Asthma
  • Lung cancer
  • Low birth weight
  • Infant mortality
• 4.3 million premature deaths in 2012 (WHO, 2014)
• We evaluate the association between indoor air pollution and cognitive function in Mexico.
  • Developing country, rapid aging.
Percentage of fuel wood users (2000)

Data & Methods

• The **Mexican Health and Aging Study (MHAS)** – large, longitudinal, household based, sample of older Mexican adults (age 50+) and their spouses.
• Data collected 2001 - 2015.
• 15,723 interviewed in 2012.
• I include 13,309 respondents age 50+ with information on cognitive function.
Indoor Air Pollution:

• Respondents are asked “the fuel that you use most to cook is…?”
  • Gas
  • Wood or coal
  • Other (oil, electricity, other) ~ 1% of sample.
Cognitive function

• Cognitive function is assessed in the MHAS using the Cross-Cultural Cognitive Examination (CCCE)
• Especially useful in populations with limited literacy and mathematical abilities (Glosser et al., 1993)
• Domains of cognitive function include:
  • Immediate recall (0-8)
  • Delayed recall (0-8)
  • Attention (0-60)
  • Verbal fluency (0-80)
  • Orientation (0-3)
Statistical Method and Covariates

- Each cognitive domain score is modeled using ordinary least squares regression.
- The association between indoor air pollution exposure and cognitive function is estimated while controlling for individual and household characteristics.
Reported Primary Cooking Fuel*

*Results are weighted using 2012 person weights.
Type of Cooking Fuel by Community Size*

*Results are weighted using 2012 person weights.
## Descriptive Results

<table>
<thead>
<tr>
<th>Household Cooking Fuel:</th>
<th>Gas</th>
<th>Wood/Coal</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
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<table>
<thead>
<tr>
<th>Demographics</th>
<th></th>
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<tbody>
<tr>
<td>Female</td>
<td>54.7</td>
<td>50.8</td>
<td>**</td>
</tr>
<tr>
<td>Age, years</td>
<td>62.3</td>
<td>63.9</td>
<td></td>
</tr>
</tbody>
</table>

| Years of Education, years | 6.5 | 2.5 | *** |

<table>
<thead>
<tr>
<th>Smoking</th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Never Smoker</td>
<td>59.5</td>
<td>65.5</td>
<td></td>
</tr>
<tr>
<td>Former Smoker</td>
<td>25.7</td>
<td>24.5</td>
<td>***</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>14.8</td>
<td>10.1</td>
<td></td>
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<thead>
<tr>
<th>Health</th>
<th></th>
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<tbody>
<tr>
<td>Chronic Conditions</td>
<td>0.82</td>
<td>0.75</td>
<td>***</td>
</tr>
<tr>
<td>Insured</td>
<td>86.2</td>
<td>80.5</td>
<td>***</td>
</tr>
</tbody>
</table>

*Results are weighted using 2012 person weights.
Parameter Estimates of Use of Wood or Coal as Cooking Fuel on Immediate Recall

Model 1 includes age, sex, educational attainment, and locality size.

Model 2 adds quartiles of wealth.

Model 3 adds household characteristics (wall, floor, ceiling materials, plumbing type, use of insecticide).

Model 4 adds chronic conditions, health insurance, and smoking.
Parameter Estimates of Use of Wood or Coal as Cooking Fuel on Attention Measure

- **Model 1** includes age, sex, educational attainment, and locality size.
- **Model 2** adds quartiles of wealth.
- **Model 3** adds household characteristics (wall, floor, ceiling materials, plumbing type, use of insecticide).
- **Model 4** adds chronic conditions, health insurance, and smoking.
Parameter Estimates of Use of Wood or Coal as Cooking Fuel on Orientation

- **Model 1** includes age, sex, educational attainment, and locality size.
- **Model 2** adds quartiles of wealth.
- **Model 3** adds household characteristics (wall, floor, ceiling materials, plumbing type, use of insecticide).
- **Model 4** adds chronic conditions, health insurance, and smoking.
Parameter Estimates of Use of Wood or Coal as Cooking Fuel on Verbal Fluency

- **Model 1** includes age, sex, educational attainment, and locality size.
- **Model 2** adds quartiles of wealth.
- **Model 3** adds household characteristics (wall, floor, ceiling materials, plumbing type, use of insecticide).
- **Model 4** adds chronic conditions, health insurance, and smoking.
Fully Adjusted Parameter Estimates of Wood/Coal Use as Cooking Fuel in Terms of Age and Years of Education

<table>
<thead>
<tr>
<th>Years of Education</th>
<th>Years of Age</th>
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<tbody>
<tr>
<td>-3.0</td>
<td>6.0</td>
</tr>
<tr>
<td>-2.0</td>
<td>5.7</td>
</tr>
<tr>
<td>-2.4</td>
<td>6.5</td>
</tr>
<tr>
<td>-1.6</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Legend:
- Years of Education
- Years of Age

Tests:
- Immediate Recall
- Attention
- Verbal Fluency
- Orientation

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Sensitivity Analysis: Number of Waves Reporting Use of Wood/Coal as Cooking Fuel

Cognitive Domains by Number of Reports of Biomass as Fuel

- Percentages calculated based on OLS regressions of cognitive scores holding age, sex, years of education, and locality size constant at their means.

- Immediate Recall
  - 1 Report: *** -3.70%
  - 2 Reports: **** -4.32%
  - 3 Reports: **** -6.77%

- Attention
  - 1 Report: *** -10.14%
  - 2 Reports: **** -8.41%
  - 3 Reports: **** -12.11%

- Verbal Fluency
  - 1 Report: **** -17.85%
  - 2 Reports: **** -10.14%
  - 3 Reports: **** -6.64%

- Orientation
  - 1 Report: **** -12.11%
  - 2 Reports: **** -12.11%
  - 3 Reports: **** -12.11%
Discussion

• Exposure to indoor air pollution was associated with decreased performance on immediate recall, attention, orientation, and verbal fluency domains.
  • Effects were equivalent to approximately:
    • 3-6 years of age
    • 1.5-3 years of education
Solutions and Challenges

• Reduce exposure to indoor air pollution by:
  • Promoting cleaner fuel sources.
  • Improving ventilation in homes.
• Many households using wood/coal as cooking fuel are located in remote areas.
  • Difficult to reach
  • Limited access to alternative fuel sources
  • Alternative sources of energy not affordable.
  • Indigenous population groups are highly traditional.
• Require collaboration with members and leaders of indigenous communities.
Acknowledgements

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References

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