Personal exposure and stove use monitor data from a randomized controlled intervention trial in Ibadan, Nigeria

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Study Background

• Randomized controlled intervention trial in Ibadan, Nigeria
  – Mostly urban setting
• Majority of women in city use kerosene for cooking
• Women in the peri-urban areas use mixture of kerosene and wood
Study Background

• This study uses a clean-burning bioethanol stove in a randomized, controlled intervention to investigate the effect of maternal exposure to HAP on fetal growth and survival
Methods

• Recruit 300 pregnant women from five primary health care centers in Ibadan, Oyo State, Nigeria

• Inclusion criteria:
  – Less than 18 weeks gestational age; exclusive use of wood or kerosene for cooking

• Exclusion criteria:
  – Smoker; cooks for a living; multiple gestation; HIV; prior C-section; 3 or more previous miscarriages; uncontrolled hypertension
Methods

• Eligible participants randomized
• Questionnaires administered at recruitment
• Nutritional biomarker data collected at baseline and 35 weeks GA on mothers
• Serial ultrasound administered 6 times throughout pregnancy
• Spirometry administered at baseline, 26 weeks GA, and 6 weeks post-delivery
Exposure and Cookstove Monitoring

- 2nd and 3rd trimester
- 72-hr continuous PM$_{2.5}$ & CO
- 72-hr integrated PAH (subset)
- 20-hr GPS

- SUMs placed on all homes in study homes
- SUMs record temperature every 10 minutes

*SUMs = Stove Use Monitors*
Estimating Cooking Time

- Stove On $\geq 35\degree C$
- Stove Off $<35\degree C$
- Periods with consecutive Stove On periods are segmented to create cooking event.
Intervention Arm Stove Usage

Percentage of Stove Use Per Month

Average % of Days/Month with Stove Usage

Month of Enrollment

Stovetype
- cleancook
- kerosene

**Data through July 10, 2014**
Intervention vs. Control Arm

Sample includes 53 Clean Cook stoves
64 kerosene stoves

Number of Cooking Event

Mean Length of Cooking Event

P-value < 0.0001
Mean = 2.6
Mean = 2.2

P-value < 0.0001
Mean = 59.3
Mean = 64.5
Monthly Variations in Cooking Time

Mean length of cooking event

Month

Minutes

StoveArm
- cleancook/intervention
- kerosene/control

Month:
- Aug2013
- Sep2013
- Oct2013
- Nov2013
- Dec2013
- Jan2014
- Feb2014
- Mar2014
- Apr2014
- May2014

Average Cooking Length

Mean length of cooking event
Background PM$_{2.5}$ Concentrations

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
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</thead>
<tbody>
<tr>
<td>2nd Trimester</td>
<td></td>
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<tr>
<td>Intervention mean</td>
<td>25.9 ± 6.8 µg/m$^3$</td>
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<tr>
<td>Control mean</td>
<td>31.8 ± 9.4 µg/m$^3$</td>
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</tbody>
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>3rd Trimester</td>
<td></td>
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</tr>
<tr>
<td>Intervention mean</td>
<td>32.8 ± 9.4 µg/m$^3$</td>
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</tr>
<tr>
<td>Control mean</td>
<td>44.3 ± 13.3 µg/m$^3$</td>
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72 hour Mean PM$_{2.5}$ Concentration

**2nd Trimester**

Intervention mean: 126.4 ± 34.7
Control mean: 163.0 ± 36.2

log transformed - p=0.05

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Average % of Days/Month with Stove Usage

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<thead>
<tr>
<th>Stovetype</th>
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<tr>
<td>cleancook</td>
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<td>kerosene</td>
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Month of Enrollment

Stovetype
- cleancook
- kerosene
Personal PM$_{2.5}$ Exposures in Urban Nigeria – complicating factors

Multi-family and multi-wife homes lead to multiple stoves
Personal PM$_{2.5}$ Exposures in Urban Nigeria – complicating factors

Generator use >80% of homes use once per week

Image: bellanija.com
Personal PM$_{2.5}$ Exposures in Urban Nigeria – complicating factors

20% of homes burn their trash

A higher percent of homes live nearby a trash burning site
Personal PM$_{2.5}$ Exposures in Urban Nigeria – complicating factors

Exposures to high concentrations near-roadways and during transit
Conclusions

• Very high usage of CleanCook Stoves
• Very little ‘stove stacking’
• 23% reduction in PM$_{2.5}$ exposure for CleanCook group in 2$^{nd}$ trimester
• 32% reduction in PM$_{2.5}$ exposure in 3$^{rd}$ trimester
• Ambient air pollution plays an important role in exposure
Next Steps

• Health analysis
  – Correlating health outcomes with exposures
• GPS analysis
• PAH analysis
• Firewood homes
Acknowledgments

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Thank You!
72-hour Mean CO

- The intervention participants on average were exposed to 23% less CO.
- There was significant overlap of exposures between the two groups.
- Overall CO exposures were relatively low.