

Prenatal Exposure to Solid Fuel Smoke and Birth Outcomes in Sri Lanka

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Background

- Household air pollution (HAP) from combustion of solid fuels for cooking and space heating is one of the ten most important risk factors contributing to the global burden of disease
- Known adverse effects of HAP include acute lower respiratory infections, chronic obstructive pulmonary disease and lung cancer
- Recent studies suggest a spectrum of other adverse effects including adverse pregnancy outcomes
- No previous research on HAP and infant neurodevelopment; **study addresses a crucial gap in HAP research**

Aims

- To estimate HAP exposure using questionnaire; and to measure the accuracy of questionnaire information by levels of indoor PM_{2.5} and CO measured in a subset of households
- To evaluate the relationship between prenatal exposure to indoor PM_{2.5} and CO from solid fuel smoke and fetal growth (low birth weight, head circumference and length) and neurodevelopment at birth and at six months (measured by Brazelton scale and Bayley III scale, respectively)
- To expand research/training capacity in HAP research including the development of RO1 application

Study Design

- **Setting:** Ragama, Western Province, Sri Lanka
- **Design:** Prospective birth-cohort
- **Sample size:** 650 mother-infant pairs
- **Eligibility:** Women who: (1) permanently reside in the Ragama area (2) are between 18 and 40 years of age; (3) are <12 weeks pregnant (1st trimester of pregnancy) at the time of enrollment; (4) plan to continue antenatal care and deliver at the Colombo North Teaching Hospital; (4) have a singleton birth; and (5) consent to participate.



Study Overview

Recruitment at the first trimester (N=650)

Ongoing study

Pollutant Measurement (each trimester)

- 2-hour measurement for PM_{2.5} and CO (N=250)
- 24-hour measurement for PM_{2.5} and CO (N=20)
- Time activity pattern (N=20)

Data Collection (N=650; each trimester):

- Baseline Questionnaire
- Anthropometric measurements
- Food Frequency Questionnaire
- Ultra-sonogram
- Medical records – Routine investigations abstracted

Birth Outcomes: weight etc.
Neurodevelopment: Brazelton Neonatal Behavioral Assessment

Birth

Six months

Neurodevelopment: Bayley III Scales of Infant and Toddler Development

Covariates

- Socio-demographic (for SES scoring system)
- Anthropometric measurements
- Obstetric history (past and current)
- Lifestyle habits (smoking – urine cotinine)
- Antenatal care
- Sexual history
- Dietary history
- Anxiety and depression (K10 questionnaire)

Current Status

Items	N
Enrollment	546
Baseline data collection	
Wood users	274
LPG users	253
Kerosene users	19
PM _{2.5} and CO monitoring in households	
1 st trimester	146
2 nd trimester	88
3 rd trimester	43
Ultrasound in 1 st trimester	389
Birth-outcomes	
Spontaneous abortions	39
IUD	1
Still births	2
Neurodevelopment assessments	
At Birth	216
6 months	52

A glimpse of field visits



Picture1. Wood cook stove



Picture 2. LPG fuel and stove



Picture 3. Wood cook stove on platform

Challenges

- Study initiation delayed
 - IRB approvals - about six months
 - Approval for buying the equipment also slow
 - Customs permission had to be obtained in Sri Lanka; had to work at different levels to circumvent duty (200%)
- Calibration of equipment in Singapore
- At least PM_{2.5} monitors were needed; had to borrow one from MU

Research Training Capacity

- Fogarty ITREOH

EOH research training capacity development in Aga Khan Univ. (AKU) in Pakistan, Univ. of Kelaniya (UKe) in Sri Lanka and Manipal Univ. (MU) in India

- Research in heavy metals, pesticides, air pollution and occupational health
 - Several HAP pilot studies – eg. exposure assessment, in-country Bayley III validation (publications, n=9; national/international presentations, n=12; 2010 award at ISEE)
 - Supplement award received for HAP research in Pakistan (2012)
- MPH program in MU (Epidemiology and EOH) and UKe (Epidemiology, EOH in 2013) and EOH certificate program in AKU

Research Training Capacity

- R21
 - In-country investigators – trained in the Fogarty program; main investigator, Sumal Nandasena, obtained PhD in environmental epidemiology in Sri Lanka (1st to obtain this degree in Sri Lanka, completed post doc at UAB)
 - Study has developed strengths in:
 - Designing and conducting a birth cohort study (follow-up studies)
 - Building further in-country expertise in HAP exposure and neurodevelopment assessment components – several trained
 - Research base for in-country investigators to conduct trainings at the national level and students in the MPH program

Next Steps

- RO1 expanding the study to include follow-up of cohort until three years of age
 - To evaluate prenatal as well as postnatal exposure to solid fuel smoke and child neurodevelopment
 - To measure specific components of air pollutants and assess their independent and joint effects on child neurodevelopment

Thank you.