# A case-control study of household air pollution and tuberculosis in women and young children in urban India

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# Background

- 9.6 million incident cases, 1.5 million deaths
    - 88% of new cases and 73% of TB deaths were in HIV-*uninfected*

<u>Disease of Poverty</u>

- Most prevalent among those in poor social and economic conditions
- Social determinants increasing risk for infection → disease
    - ✓ Undernutrition
    - ✓ Tobacco Smoking
    - ✓ Crowding
    - ✓ Alcohol Abuse
    - ?? Household Air Pollution



Lonnroth_Soc Sci Med_2009
WHO_Global TB Report_2015

# Household Air Pollution (HAP)

- Complex mix of by-products from household-based combustion
  - Some major contributors: Cooking/heating fuel, SHS, mosquito coils

- Associated with other respiratory diseases: ALRI, COPD, asthma, lung cancer

  → Not definitively associated with TB
  - Meta-analysis: OR 1.6 (95% CI: 0.7-3.6) when restricted to females
  - Lakshmi 2012 (India): 3.14 (95% CI: 1.15 – 8.56)
  - Pohkrel 2010 (Nepal): OR 1.21 (95% CI: 0.48 – 3.05)
    - Kerosene Stove: OR 3.36 (95% CI: 1.01-11.22)



Gordon_Lancet_2014
Sussan_2014

# Study Location

**India**

- 2.2 million incident cases (23% of global burden)
- 220,000 deaths
- TB epidemic not driven by HIV
- 64% of Indian households use biomass fuels (Rural: 81%; Urban: 26%)


**Pune District**

- Large district located in state of Maharastra
- 5.7 million urban, 3.7 million rural
- Annual TB Incidence: 185/100,000
- Byramjee Jeejeebhoy Medical College and Sassoon General Hospital (BJMC/SGH) – large tertiary public hospital



† Graham_JID_2012
India RNTCP

# Methods

Matched case-control study

- Cases

  Inclusion: <5 years of age or adult women presenting at BJMC/SGH and diagnosed with TB

  Exclusion: HIV infection, diabetes

- Controls

  Inclusion: Randomly selected from same neighborhood, age (± 12 months for children, ± 5 years for adults) and sex matched

  Exclusion: HIV infection, diabetes, positive for TB symptom screen

Statistical Methods

- Conditional logistic regression for matched data
  - Outcome → TB
  - 1° Exposure → Log-transformed 24-hour $PM_{2.5}$
- Predictor variables of interest: $p < 0.20$ in univariate analysis or *a priori*

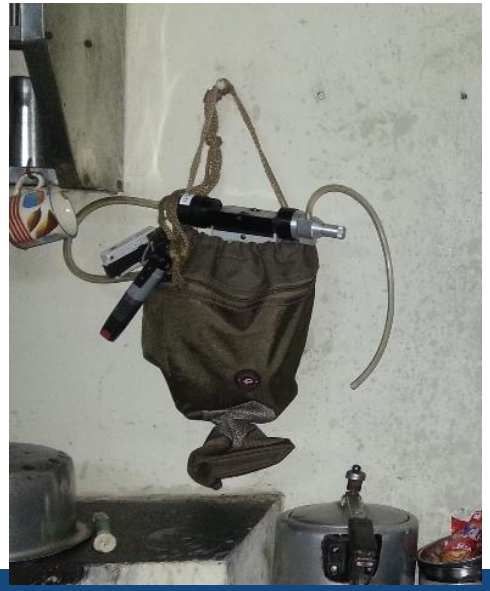
# Exposure Assessment

**Questionnaires and Reported Measures**

- Socio-demographic
- Fuel use patterns
- Secondhand tobacco smoke

**Environmental Exposure Assessment: $PM_{2.5}$**

- 24-hour $PM_{2.5}$ (PM < 2.5 microns diameter)
    - Important product of combustion
    - Highly regulated and monitored
- 1 x 1 meter away from primary cook stove

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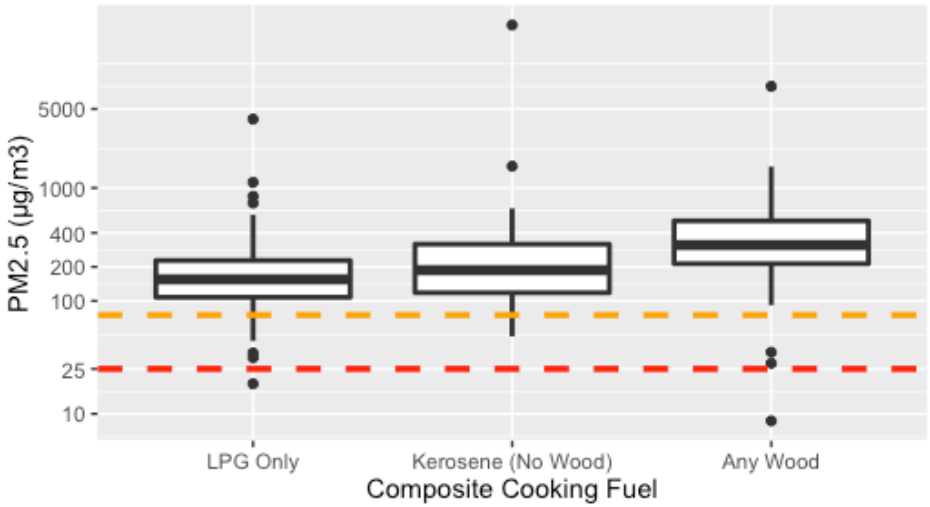
# Reported Exposure to Pollutants: Cooking Fuel

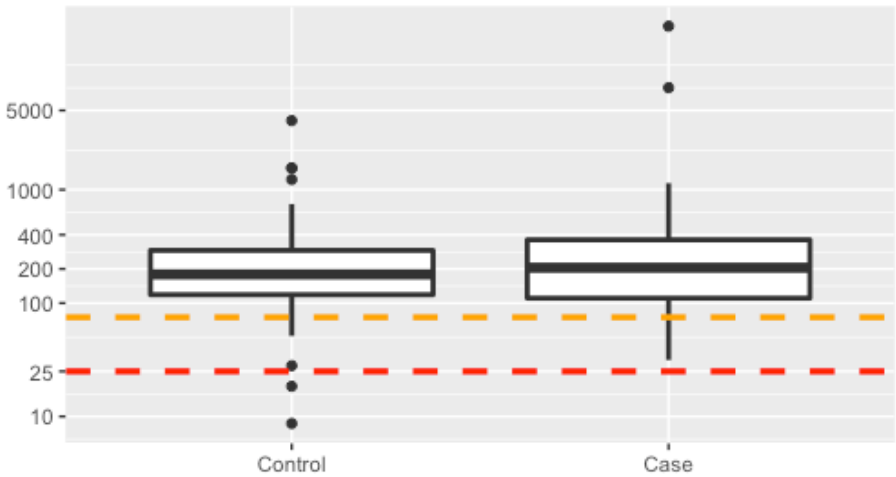
| | n=156 |
|---|---|
| Primary Cooking Fuel, n(%) | |
| LPG or Electricity | 134 (86) |
| Kerosene | 17 (11) |
| Wood | 5 (3) |
| Secondary Cooking Fuel, n(%) | |
| None | 83 (53) |
| Electricity/LPG | 18 (12) |
| Kerosene | 19 (12) |
| Wood | 36 (23) |
| Composite Cooking Fuel, n(%) | |
| LPG/Electricity Only | 87 (56) |
| Kerosene (but no wood) | 28 (18) |
| Any Wood | 41 (26) |

# 24-hour Time-weighted Average $PM_{2.5}$

Overall Median Concentration: 182 µg/m$^3$ (IQR: 114 - 318)




Composite Cooking Fuels




Controls vs Cases

World Health Organization $PM_{2.5}$ 24-hour Guidelines: **25 µg/m$^3$**
Interim Target: **75 µg/m$^3$**

# Study Limitations and Strengths

Limitations

- Single measure of household $PM_{2.5}$
- Ubiquitously high levels of exposure
- Unmeasured confounders

Strengths

- Objective measures for exposure classification: $PM_{2.5}$
- Contribution of a variety of sources of exposure
- Vulnerable, hard to reach population
- Inclusion of children

# Discussion

- Higher concentrations of $PM_{2.5}$ tended to be associated with TB
- Higher magnitude of effect with reported use of kerosene
  - Cooking location
  - Need for additional studies due to contribution to particulate mass measurements
- First study assessing association between TB and objective markers of combustion in home

<u>Importance of Socioeconomic Determinants</u>

- Prevention (37% of estimated new cases undiagnosed/not reported)
- Useful for identifying those at greatest risk
  - Screening strategies
  - Active case-finding
  - Targets for preventive therapy

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