HOUSEHOLD AIR POLLUTION LEVELS IN RURAL HOUSEHOLDS USING BIOMASS FUEL IN ZIMBABWE

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Background of the researcher

• Shamiso Muteti
• Public Health Lecturer
  – Department of Community Medicine, College of Health Sciences University of Zimbabwe (UZ)
• Joined MEPI junior faculty programme in 2016
• Scientific area
  – Respiratory health
Research project

• Household air pollution and respiratory health status among adult women in rural and urban communities in Zimbabwe
  – To quantify HAP (particulate matter, PM$_{2.5}$) levels in rural households using biomass fuel in Zimbabwe

PM$_{2.5}$ refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers
Introduction and background

- Nearly a third of the world’s population use biomass fuel (WHO, 2014)
- Biomass fuels are smoky, result in HAP when the smoke is poorly vented
- WHO estimates
  - 4 million people die prematurely/yearly from illness attributable to HAP each year (WHO, 2018)
    - Most health effects are thought to be related to the fine particulate matter component of HAP
- Women experience high exposures due to gender based domestic roles
Respiratory outcomes associated with HAP

• Strongly associated
  – Chronic Obstructive Pulmonary Diseases - Emphysema, chronic bronchitis
  – Acute respiratory tract infections/pneumonia
  – Lung cancer
  – Tuberculosis

• Weakly associated
  – Asthma
  – Interstitial lung disease

Kurmi et al 2011, Lim & Seow 2012, Chafe et al., 2014; Fullerton et al., 2011; Gordon et al., 2017; Kodgule and Salvi, 2012
Context of the study

• Rural set up, use biomass
• Round stand alone kitchens with cone shaped roofs made up of thatch
  – Few households have brick under asbestos kitchens with chimneys
Rationale

• 67.72 % of Zimbabweans reside in rural areas (Zimstats 2016)
  – 94% of rural households in Zimbabwe use biomass fuel (ZDHS 2015/16)

• Paucity of data on;
  – HAP exposure levels
  – Burden of biomass fuel-related adverse effects in Zimbabwe

• Epidemiological evidence can help build the country exposure database
  – enable an objective assessment of health risk.
Research question

• What are the HAP (PM$_{2.5}$) levels in rural households using biomass fuel in Zimbabwe?

Research objective

• To quantify the HAP (PM$_{2.5}$) levels in rural households using biomass fuel in Zimbabwe
Methods

- Study design – Cross sectional
- Study population – Households using biomass
- Study setting – Goromonzi rural, Zimbabwe
- Sampling frame – Zimbabwe Central Statistics register of households in Goromonzi
- Sampling period – September to December 2017 (summer)
Methods : Air sampling

• Calibrated Airmetrics MiniVol Portable Air Sampler (Airmetrics, 2014) was used to collect static samples of respirable PM$_{2.5}$ over 24hrs
  – Flowrate of the air sampling pump was 5l/minute
  – Air sampler was mounted on a tripod stand about 1.5 – 2.0 meters off the ground and 0.5 – 1.0 meters from the stove in order to approximate the cook’s location.

• Pre and post exposure weighing of filters using a microbalance (Gravimetric method)

• Use of a lab with controlled temperature and humidity
Methods

- Time activity diaries were developed on;
  - Time spent cooking per day
  - Number of meals cooked per day
  - Type of biomass that was used
  - Opening of windows and doors during cooking times
  - Type of lighting used in the home
  - Presence of a smoker during the time
Ethics

• All ethical procedures were done
  • Mash East IRB - granted
  • JREC – granted
  • Medical Research Council of Zimbabwe – granted

• Written informed consent was sought from the households
Results

• Targeted 126 households and repeated in 10% of them
  – 80% reported spending an average of 3hrs/day cooking
  – Most households prepare at least 2 meals/day
  – Wood and crop residue are the most commonly used types of biomass
  – 50% reported opening windows and doors whilst cooking
  – Candles and paraffin lamps are the most commonly used lights
Results, cont’d

• Concentrations of respirable PM$_{2.5}$ ranged from 13.9 $\mu$g/m$^3$ to 4694.4 $\mu$g/m$^3$ over 24 hours.
• Median dust weight was 2.6mg, IQR(1.5-3.9mg).
• Median dust concentration was 354.2 $\mu$g/m$^3$, IQR(208.3-541.7$\mu$g/m$^3$)

*NB WHO indoor air quality standards PM$_{2.5}$
25 $\mu$g/m$^3$ 24-hour mean
10 $\mu$g/m$^3$ annual mean
Conclusion and recommendations

Conclusion

• Indoor PM$_{2.5}$ levels were relatively high, over 90% having levels above the 24-h guideline of 25 $\mu$g/m$^3$ set by the WHO.

Recommendation

• Education awareness campaigns on the importance of ventilation to promote clean air
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• Households that agreed to participate
THANK YOU