

Dionisio KL¹, Howie S², Dominici F¹, Fornace KM³, Adegbola RA², Spengler JD¹, Ezzati M⁴ (2011)
“Calculating the exposure of infants and children to particulate matter from biomass fuels in The Gambia”

Affiliations:

¹Harvard School of Public Health, Boston, MA

²Medical Research Council Laboratories, Fajara, The Gambia

³Royal Veterinary College, London, UK

⁴Imperial College London, London, UK

Background and aims

Smoke from biomass fuels is a risk factor for pneumonia, the leading cause of child death worldwide. While particulate matter (PM) is the metric of choice when evaluating the health effects of biomass smoke, measuring children’s exposure to PM is very difficult. Previous studies have used indirect methods to estimate children’s PM exposure, including using carbon monoxide (CO) as a proxy for PM, and using time-location-activity budgets in combination with microenvironment PM monitoring. The validity and comparability of these indirect methods is not known. We report on a study which used multiple methods to quantify children’s exposure to PM, and validated estimates from indirect methods against direct measurements.

Methods

Two estimates of personal exposure of children in The Gambia to PM were compared to a directly-measured personal PM exposure. A parsimonious mixed effects model was previously used to predict usual 72-h personal CO exposure for 1,200 children. 186 co-located 72-h cookhouse measurements of CO and PM were used to model the CO-PM relationship, with the model including a natural spline to account for non-linearity. In addition, for 60 children time-location-activity budgets and continuous PM measurement in the cookhouse were used to calculate a second estimate of personal PM exposure. For 25 children, these two estimates were compared to a direct measurement of personal PM exposure.

Results

72-h CO and PM concentrations in the cookhouse had a correlation coefficient of 0.85. Based on Bayesian model selection, the CO-PM relationship was best described by a model including CO with a natural spline with 2 degrees of freedom, type of fuel used, season of measurement, and study site. Preliminary results show a mean calculated 72-h PM exposure on children of $112 \pm 32 \mu\text{g}/\text{m}^3$.

Conclusion

Children’s exposure to PM_{2.5} in The Gambia is well above WHO Air Quality Guidelines. The results of multiple measurement methods can be combined to estimate children’s personal PM_{2.5} exposure.