

Title: Are cleaner cooking solutions clean enough? How can we scale them up in sub-Saharan Africa? Evidence from a systematic review and multinational studies (CLEANAir(Africa) & PURE-AIR)

Time/Date: November 10, 2021, 8-9:30AM Mountain Time / 10-11:30AM Eastern Time /3-5:30 UCT

Unasked/answered Panelist Questions:

Question: In the PURE-AIR study, why did females and males in homes using electric stoves have some black carbon exposures if there are no BC emissions from these stoves?

Answer: Infiltration of BC from the ambient environment from other sources (e.g. agricultural field burning).

Question: How was LPG consumption determined based on the self-reported survey data?

Answer: Using two different variables: number of cylinder refills per year or average time between refills. Both of these variables could be multiplied by cylinder size and divided by family size

Question: You mentioned that you were measuring Black Carbon in your PURE studies - can you talk about whether you measured organic carbon as well as black carbon and what takeaway messages that you might want to share?

Answer: We only measured black carbon. More info about the reflectance measurement method used in PURE-AIR is here:

Jeronimo M, Stewart Q, Weakley AT, et al. Analysis of black carbon on filters by image-based reflectance. Atmospheric Environment 2020; 223: 117300.

Key messages were similar to PM2.5: there was huge variation in absorbance levels between communities/countries. Those cooking with clean fuels in China and northern India had high levels of BC (likely because of agricultural field burning which is a significant source of BC in these regions). Having significant BC exposures even when using clean stoves (for example electric stoves in China) highlights that other sources of BC emissions (field burning) need to be addressed as there is likely significant infiltration into indoor spaces.

Question: Do you have any recommendations of resources to help locals transition from using solid fuel to LPG?

Answer: Would depend on the context, but engaging with commercial companies or NGOs operating/promoting clean cooking stoves/fuels in the local area can help spread the word or provide locally-relevant information. There are a variety of startups operating in various

countries. A good resource for this is the Clean Cooking Alliance (here is the resource centre page): <https://cleancooking.org/sector-directory/resources-centre-for-sustainable-development/>

Please email for more specific info: m.shupler@liverpool.ac.uk

Immediate solutions in the absence of LPG can be to cook in an outdoor area or indoor space with a lot of ventilation (windows, leave door open). Don't remain in the cooking area/kitchen during entire cooking process, only when needing to stir the pot.

Question: Do you have recommendations of pollutants beyonds PM and CO that would be of particular interest for LPG cookstoves./In terms of going forward, what pollutants do you think would be good to start measuring in this field? Also to understand health impacts?

Answer: Nitrogen dioxide for health impacts, black carbon/elemental carbon (multiple ways to measure) for climate impacts.

Question: Was background PM concentrations systematically subtracted to exposure PM concentration presented for each situation? That means 75 ug/m³ for electric cooker is because of frying by instance or other indirect cooking PM emission?

Answer: We didn't link concentration to exposure at an individual level. Likely this is due to stove stacking or ambient contamination rather than type of electric cooking.

Question: Did you adjust your exposure data with real time spent (measured) by cooker in the cooking area (generally around 30%) namely during biomass ignition phase?

Answer: That information was not available for the majority of studies included in the review.

Question: Are you sure you can compare fossil fuel like LPG to a potential renewable biomass? To remember time to restore LPG 100 000 000 years, time to restore biomass 30 to 100 years? not so comparable no?

Answer: Modelling article for health and climate impacts in Cameroon available. Environ Health Perspect.

Question: What's your feedback on using spirometer to evaluate pollution exposure impact. Is it a valuable tool for such studies?

Answer: Difficult and costly to measure, not a good proxy for HAP (other sources eg. smoking, ambient etc). Our use is to benchmark restriction in lung function in rural biomass users in Cameroon to contrast with Cameroon BOLD study (CAA wants to support PIs from across the partnership).

Related publications to date:

1. Pope D, Johnson M, Fleeman N, Jagoe K, Darte R, Madan M, Bruce N, Shupler M, et al. Are cleaner cooking solutions clean enough? A systematic review and meta-analysis of particulate and carbon monoxide concentrations and exposures. *Environmental Research Letters*. 16, 083002
2. Shupler M, et al. Household and Personal Air Pollution Exposure Measurements from 120 Communities in 8 Countries: Results from the PURE-AIR Study. *The Lancet Planetary Health*. 2020 Oct 1;4(10):e451–62
3. Shupler M, et al. Modelling of supply and demand-side determinants of LPG consumption in peri-urban Cameroon, Ghana and Kenya. *Nature Energy*. <https://www.nature.com/articles/s41560-021-00933-3>