PRESENTING AUTHOR'S NAME & RESEARCH TITLE

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Novel methods of assessing household wood smoke exposure in the rural Mountain West

PURPOSE/BACKGROUND

Residential wood smoke (WS) exposure has emerged as a critical public health issue in many US communities where wood burning compromises indoor air quality and contributes to a large portion (>50%) of ambient particulate matter (PM) pollution in winter. Gap-in-knowledge remains regarding the dose-response relationship between WS exposure and health effects in vulnerable populations in the US. This multi-site pilot project focuses on the development of two novel WS exposure assessment tools in a multiethnic cohort of elderly people from the rural MW: the Household Exposure to Wood Smoke (HEWS) and macrophage carbon load (MaCL).

MATERIALS & METHODS

A panel study design is used to administer the questionnaire and collect bio-specimens (sputum and mouth rinse) from study subjects: 25 each from New Mexico, Alaska, Montana, and Idaho in the shoulder and peak heating seasons. Hispanics and Native Americans are oversampled in Alaska, New Mexico, and Idaho. Images obtained from 69 sputum slides from the Lovelace Smokers cohort were used to develop an artificial intelligence-based algorithm for quantifying MaCL levels.

RESULTS

Approximately 267 people have filled out our short screener to express interest in the study. We are currently enrolling study subjects and we have enrolled 70 participants across the four sites. Facebook and Craigslist advertisement have been the most efficient way to enroll study subjects. New Mexico and Montana initiated the shoulder heating season survey, whereas Alaska and Idaho will need to flip the design and conduct the peak heating survey first then shoulder heating next March/April. We successfully developed a Machine-Learning algorithm for Engulfed cArbon Particles (MacLEAP), a very first-of-its-kind artificial intelligence algorithm that integrates the Mask Region-based Convolutional Neural Network (R-CNN) to recognize and segment the macrophages from other cell types on sputum images and quantifies engulfed particles. We trained this Mask R-CNN based MacLEAP algorithm using a total of 1647 bright-field Papanicolaou staining sputum images obtained with a 100× oil immersion objective from 69 LSC members. Mask R-CNN-based MacLEAP algorithm was able to yield perfect correlations with manual counting, a **gold standard** for MaCL scoring, for the number of black carbon particles (R^2=0.90**)** and areas of particles (R^2=0.79). Moreover, an almost identical magnitude of associations between ultra fine particulate matters (PM2.5) and MaCL levels and between MaCL levels and plasma CC16 levels was identified between manual scoring and AI counting.

DISCUSSION/CONCLUSION

We have successfully established an IRB approved protocol and a multi-site research team who are able to enroll study subjects exposed to indoor wood smoke during winter heating. The enrollment so far serves as a good foundation for subsequent execution of a planned protocol to assess the impact of indoor wood burning on air quality and lung health. This innovative Mask R-CNN based MacLEAP will provide a high-throughput and scorer-independent approach to quantify MaCL levels for large-scale epidemiological studies.