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NEWS

Correlation Between Imaging and Environmental Factors in a Population of Cooks Using Biomass Fuels

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PURPOSE

We sought to characterize the impact of cookstove pollutants in a rural population, using quantitative computed tomography (QCT) and in-home assessments of environmental exposures.

METHOD AND MATERIALS

We assessed the homes of 21 subjects cooking with LP gas or wood biomass. Environmental assessments included real-time PM<=2.5μm (PM2.5) concentrations, black carbon, sediment mass, and endotoxin level. Large particulate matter was analyzed for metal composition and applied to human airway epithelial cells in culture to measure in-vitro airway cell permeability. QCT was performed via a GE Optima 128 slice scanner utilizing a standardized protocol at coached total lung capacity (TLC) and residual volume (RV). Image analysis included air trapping derived from a disease probability map (VIDA Diagnostics), Mean Jacobian, and a local anisotropic deformation index (ADI). k-means clustering using image-based metrics was applied to classify subjects into two groups. Posthoc analysis was used to identify environmental predictors influencing differences between the clusters.

RESULTS

Biomass cooks had significantly higher %air trapping (36.3 ± 28.3% vs. 20.8 ± 11.6%, p=0.05) and increased exposure to PM2.5 (129.6 ± 177.1μg/ml vs. 39.5 ± 13.3μg/ml, p=0.05) and endotoxin concentrations (2.1±1.8 vs. 0.5±0.1 x106 EU/m2, p<0.01). Strong pairwise correlations were observed between imaging metrics (Jacobian mean, ADI mean, and Percent Air trapping), and environmental factors (PM2.5, total rug mass, endotoxin concentration, and concentrations of Chromium, Radium, Sulphur, and Rubidium). Clustering generated a subset of 5 subjects with significantly altered lung function as defined by image metrics. Post-hoc analysis identified cell permeability, black carbon, and endotoxin concentration as top environmental markers with Sulphur, Uranium, Strontium, and Niobium demonstrating greatest prediction potential among metals.

CONCLUSION

Subjects cooking with biomass experience greater alterations in image-based metrics of lung function. Using a subset of potentially vulnerable subjects, the environmental markers with greater prediction potential have been identified, independent of fuel type.

CLINICAL RELEVANCE/APPLICATION

With the CT-based phenotyping of the lungs and characterization of associated environmental markers, solutions for disease mitigation will be better informed.