Compared to national rates, Appalachian Kentuckians have 50% higher rates of adult asthma and chronic obstructive pulmonary disease (CDC, 2018). The region also has disproportionately poorer respiratory outcomes including higher rates of asthma hospitalizations and mortality due to chronic pulmonary obstruction.

The Mountain Air Project (MAP) is a community-based participatory study which seeks to better understand the relative contributions of environment and health behaviors on respiratory illnesses in Appalachian Kentucky.

AIM #1
Investigate the extent, nature, and source of respiratory health inequities through a community-engaged assessment of environmental and individual-level exposures.

AIM #2
Enhance community knowledge about respiratory illness and refine a culturally appropriate environmental public health action strategy.

AIM #3
Test the effectiveness of the environmental public health action strategy by implementing and evaluating interventions involving self-management and changes to the home environment.
Residents formed a community advisory board (CAB) which expanded the study area, revised the survey instrument, and provided guidance on all phases of data collection.

Residents noted that mountain communities reside within watersheds or hollow (pronounced “holler”) and recommended that these be used as the unit of sampling. Forty USGS 14-digit hydrologic units (HUC) corresponding to hollows with adequate populations were selected.

Field staff used on-the-ground enumeration to define the sample frame. Community health workers (CHWs) recruited adult participants within HUCs using a randomly selected starting point and proceeding to every nth home.

A subset of 71 participants also received in-home air quality monitoring for PM 2.5, radon, CO and humidity.

CHWs collected a comprehensive survey of health history, home environment, health behaviors and spirometry on one adult in each participating household (n=972).

972 surveys were completed with a participation rate of 81.6%. Participation rates exceeded 80% in 28 of 40 HUCs. Community engagement was highest in HUCs in which the CHW lived or had family and social connections. The ratio of household contacts needed to generate a completed interview was 1.52 to 1.

KEY FINDINGS

Participants residing in public housing apartments had a significantly increased (nearly two fold) higher risk (RR: 1.93; 95% CI: 1.22-3.06) of current asthma in comparison to persons living in single family homes, after control of known asthma risk factors.

Increasing roadway traffic density was associated with an increased risk of current asthma, with a significant two fold high risk (RR: 2.05) at the highest tertile of roadway traffic density compared to the lowest tertile in the fully adjusted models. This result has also been found in fully adjusted models with ever having asthma.

The risk of current asthma increased as the proportion of the area (HUC) composed of abandoned mining areas increased; there was a 53% increased risk of current asthma (RR:1.53; 95% CI 0.98 - 2.38) in the highest tertile compared to the lowest tertile of abandoned mine area. Proximity to areas of past coal mining activity may be associated with self-reported current asthma.
Levels of radon in MAP households (N=71) were generally low over a 96 hour in-home sample duration, with an average of 1.4 pCi/L (min= 0.2, max= 6.5 1.4 pCi/L) and only 4% (3 homes) above the EPA action level of 4 pCi/L.

The average level of PM 2.5 in MAP homes (N=71) was 35.3 ug/m3 (min=1.6, max=280.9) over a 96 hour in-home sample duration, with 20% (14 homes) above the EPA action level of 35 ug/m3 over a 24 hour period. Higher PM 2.5 levels were primarily associated with the presence of indoor smokers.

Residents living in homes with higher levels of PM 2.5 experienced nearly 4x the odds of abnormal pulmonary function (restrictive or obstructive), relative to those residing in homes with lower levels of PM 2.5 (OR=3.86; 95% CI: 1.07, 13.9), in fully adjusted models comparing the upper tertile of PM 2.5 versus the lower two tertiles.

Residents spending more time inside their home experienced nearly 5x the odds of abnormal pulmonary function (restrictive or obstructive), relative to those spending less time inside their home (OR=5.35; 95% CI: 1.46, 19.6), in fully adjusted models comparing the upper tertile of time spend inside the home versus the lower two tertiles.

Contrary to national trends, a higher proportion of men (23.69%) than women (16.11%) demonstrated airflow obstruction by spirometry (FEV1/FVC <.70). While tobacco smoke is the primary cause of obstruction, occupation also plays a role, with 80% of men having work history in underground mining, surface mining, logging and milling, highway construction and repair, and/or home and residential construction. Cumulative tenure in these “dusty trades” is a modest but significant predictor of pulmonary obstruction (PR 1.02 (95% CI 1.01 -1.03).

THE ENVIRONMENTAL PUBLIC HEALTH ACTION STRATEGY - IMPROVING ASTHMA OUTCOMES IN ADULTS

CAB members reviewed the preliminary findings and used these to craft a RCT intervention for adults with asthma (n=200).

Participants receive up to four visits from an RN trained in asthma self-management education (Association of Asthma Educators) and Healthy Homes strategies for reducing environmental allergens (Healthy Home Solutions).

A Healthy Homes worker, trained by local nonprofit housing partners and Healthy Homes Solutions, inspects the home, identifies sources of allergens with the homeowner and assists with planning remediation.

Participants also receive incentive gifts aimed at improving their symptom control such as an inhaler spacer, a hypoallergenic mattress cover and a green cleaning kit. Participants receive $40 each for pre and post intervention surveys.

### PRIMARY OUTCOMES:

Asthma symptoms days in past 14 days. Urgent care visits in past 3 months, Asthma Quality of Life Score.
The Mountain Air Project has received funding from the National Institute of Environmental Health Sciences under grant number 5 R01 ES024771-05. We are grateful to the Community Advisory Board for the Mountain Air Project and the research participants of the MAP study in Harlan and Letcher counties in Kentucky. The views expressed in this report are solely those of the authors.

Katie Cardarelli, PhotoVoice
This research project (2018) engaged youth (ages 12-18) in Letcher County to capture their perspectives of indoor and outdoor determinants of respiratory illness through a participatory action approach called PhotoVoice. During this project, youth were trained on the basics of respiratory illness causes and exacerbating factors. They were also trained on how to capture meaningful photographs and to write captions about each photograph in a journal. The long term goal is to enhance youth capacity in this underserved population to participate in health disparities research.

Joslyn Isaac, Asthma Control In Children
This research project involves in-depth interviews with the parent/guardian of children (ages 6-17) with asthma to obtain information on the child's perception and knowledge of asthma, as well as the adherence to and the challenges of asthmatic treatment and management. The focus is on learning how asthma treatment and management is adhered to as a family unit. The participants are identified from the enumeration surveys from the MAP study and reside in Harlan and Letcher counties.

Jamie Sturgill, The BREATHE Study
Sphingolipids are a class of bioactive lipid metabolites which play a multifaceted role in lung inflammation and may account for the immunopathology of asthma. Researchers hypothesize that these sphingolipids may be responsible for the pulmonary dysfunction seen in patients with asthma across Appalachia that have been exposed to a host of environmental insults including mold, smoke, silica and/or coal dust. Using a non-invasive technique to assess sphingolipid levels in the breath of normal healthy subjects as well as those patients with pulmonary complications from Letcher County, researchers are examining the role of sphingolipids in pulmonary inflammation in order to develop early detection screens and targeted therapies for the prevention of advanced pulmonary disease.

ANCILLARY STUDIES

Susan Westneat
Data Analyst/ Survey Research

Katie Cardarelli
Epidemiology/Health Education

Lynda Charles
UK Finance & Logistics

Wayne Sanderson
Environmental Health

Jamie Sturgill
Pulmonary Medicine Faculty

Dave Mannino
Pulmonary Medicine Faculty

Maddie Dunfee
MD/Ph.D. Student

Joslyn Isaac
Medical Student

Brady Scott
Respiratory Therapist/ RUSH

Jay Christian
Epidemiology/GIS

John Flunker
Epidemiology/ Exposure Assessment Ph.D. Student

Steven Browning
Principal Investigator

Nancy Schoenberg
Principal Investigator

Beverly May
Project Manager

Nell Fields
Community Engagement