



University of Hawaii, MANOA



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THE ECONOMIC RESEARCH ORGANIZATION  
AT THE UNIVERSITY OF HAWAII

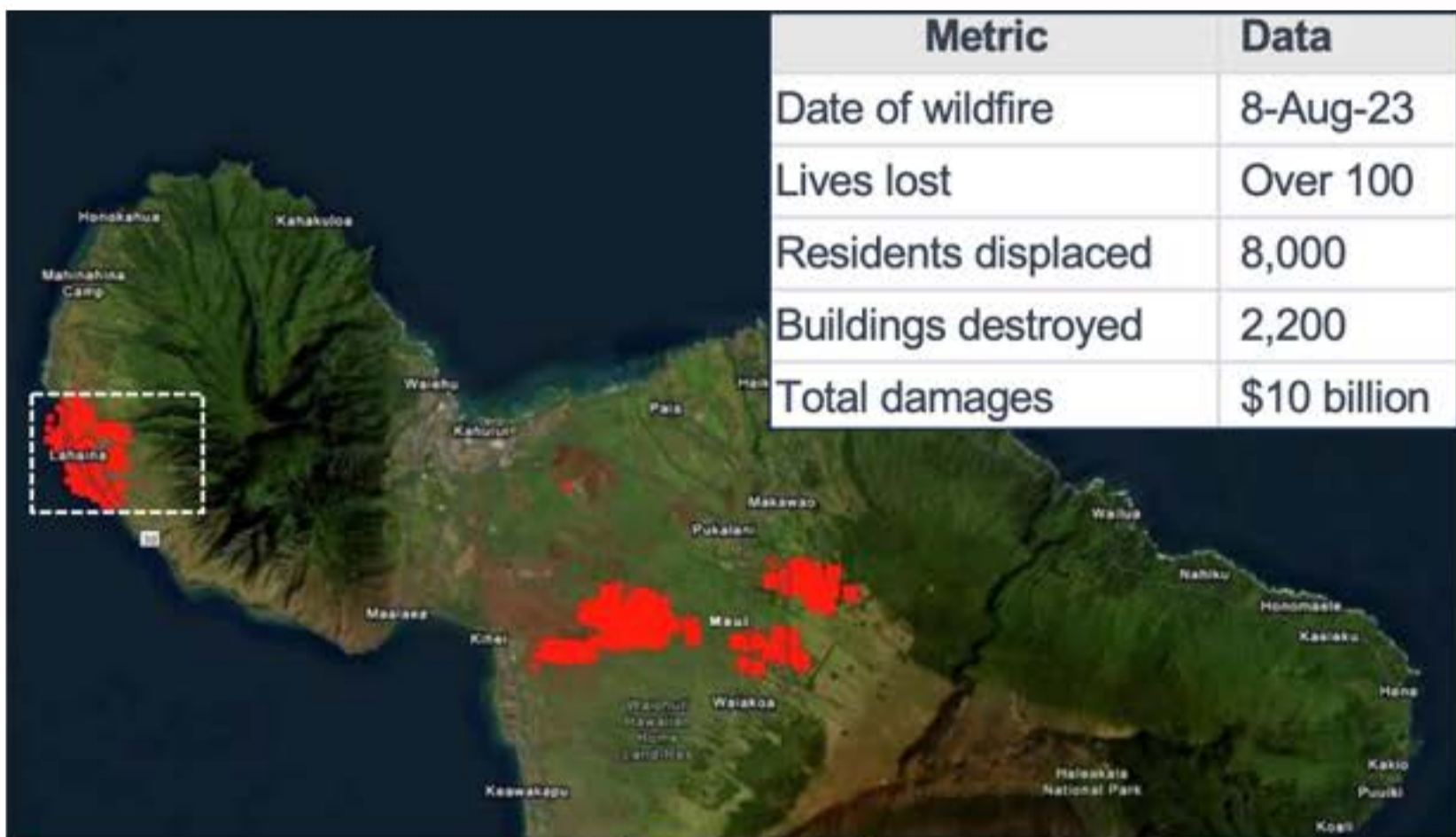
## Maui Wildfire Exposure Study

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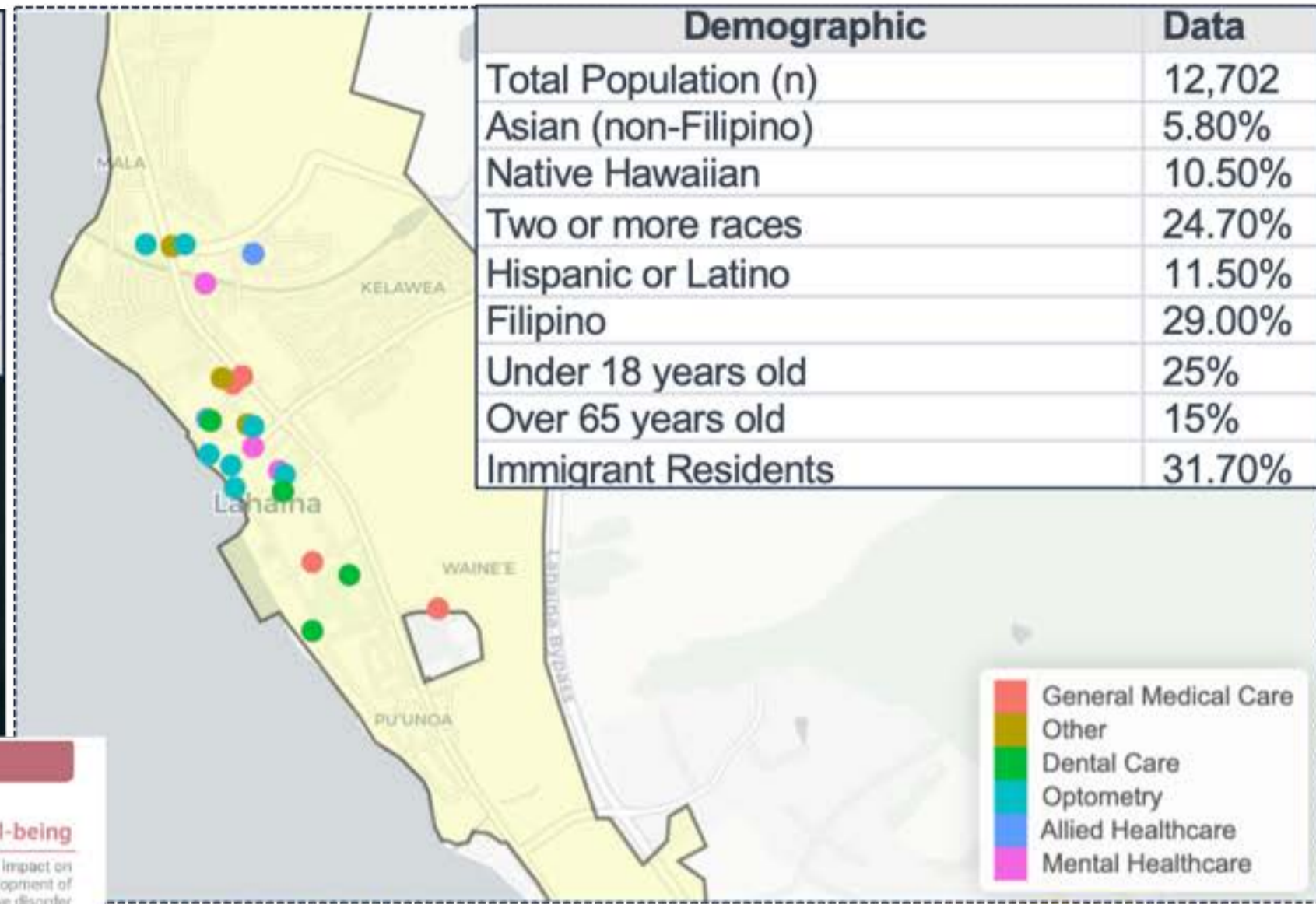
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[MauiWES.info](http://MauiWES.info) for more information

# August 2023 Fires on Maui - Population and Connection



Metric	Data
Date of wildfire	8-Aug-23
Lives lost	Over 100
Residents displaced	8,000
Buildings destroyed	2,200
Total damages	\$10 billion



**Short to Mid-Term Effects of Exposure**

**Headaches, dizziness, reduced O<sub>2</sub> transport**  
Smoke pollutants (including CO and CO<sub>2</sub>) can reduce oxygen transport, causing symptoms of oxygen deprivation.

**Eye irritation and vision complications**  
Fine particulate matter can directly irritate the eyes.

**Respiratory irritation and reduced lung function**  
Fine particulate matter (PM<sub>2.5</sub>; can include inorganic compounds, heavy metals, etc), gases (CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, etc), volatile organic compounds (aldehydes, benzene, etc), and other pollutants irritate lungs and throat.

**Cardiovascular stress and complications**  
Smoke pollutants (including CO) can reduce oxygen-carrying capacity of blood. Such cardiovascular stressors can lead to cardiovascular complications and exacerbate existing heart conditions.

**Long-Term Effects of Exposure**

**Negative impact on psychological health and well-being**  
Community proximity to and consequences of wildfire events can leave a lasting impact on emotional and psychological well-being. Such an impact can lead to the development of disorders including post-traumatic stress disorder (PTSD), major depressive disorder (MDD), and anxiety, among other negative experiences.

**Increased risk for cancer and respiratory illnesses**  
Long-term exposure to fine particulate matter can lead to the development of chronic respiratory conditions like chronic obstructive pulmonary disease (COPD), asthma, and bronchitis. Such pollutants may include polycyclic aromatic hydrocarbons (PAHs), which are carcinogenic. Additional physiological stressors can lead to compromised immune functioning, increasing risk for infection.

**Increased risk for heart attack and stroke**  
Chronic exposure to airborne pollutants can prolong irritation and inflammatory responses. Such long-term stress on cardiovascular pathways can cause hypertension and increase risk for cardiometabolic disorders.

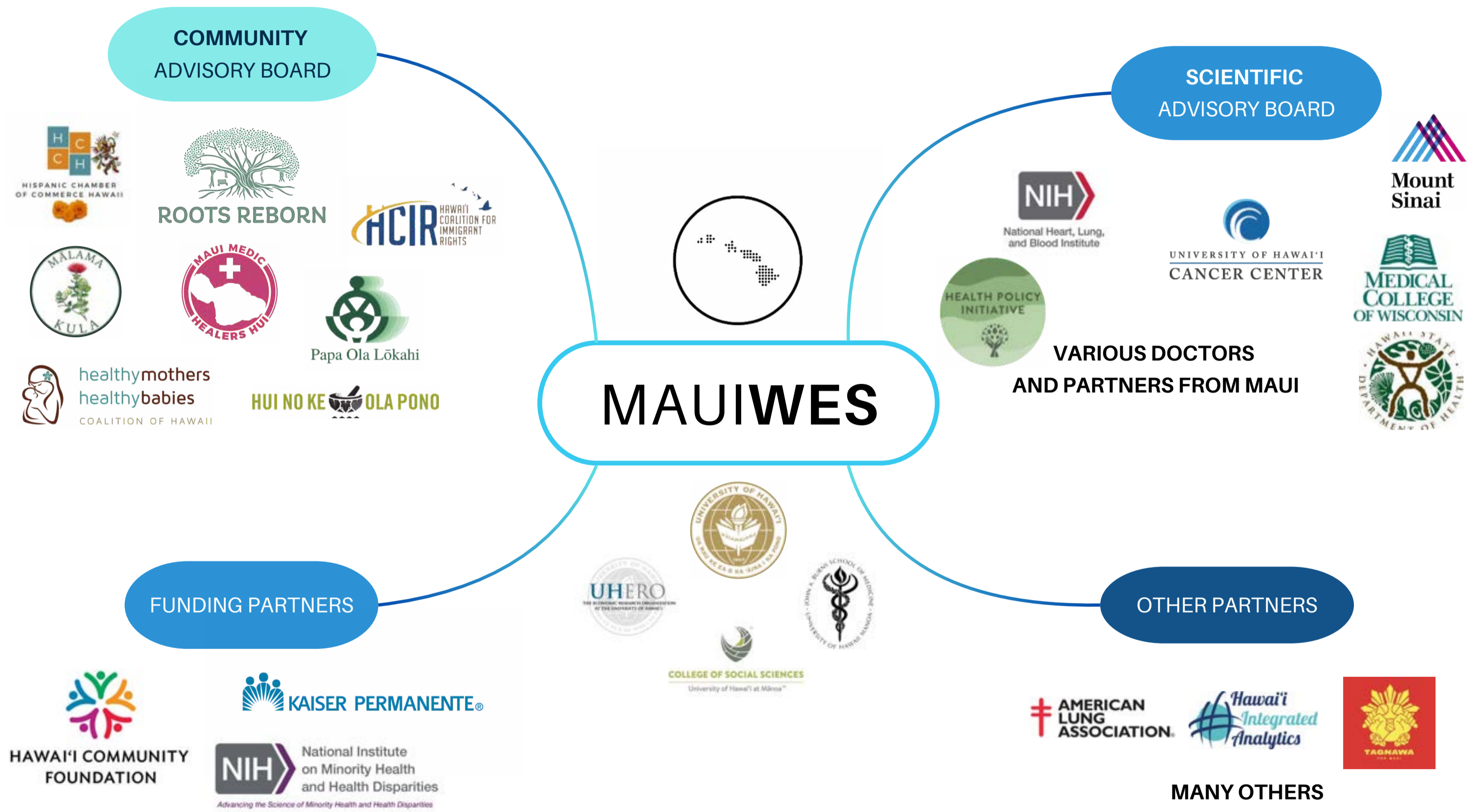


*“Aloha Lahaina”  
– K. Maunakea  
Kula born, Haku Mele  
& Hawaiian Healer*

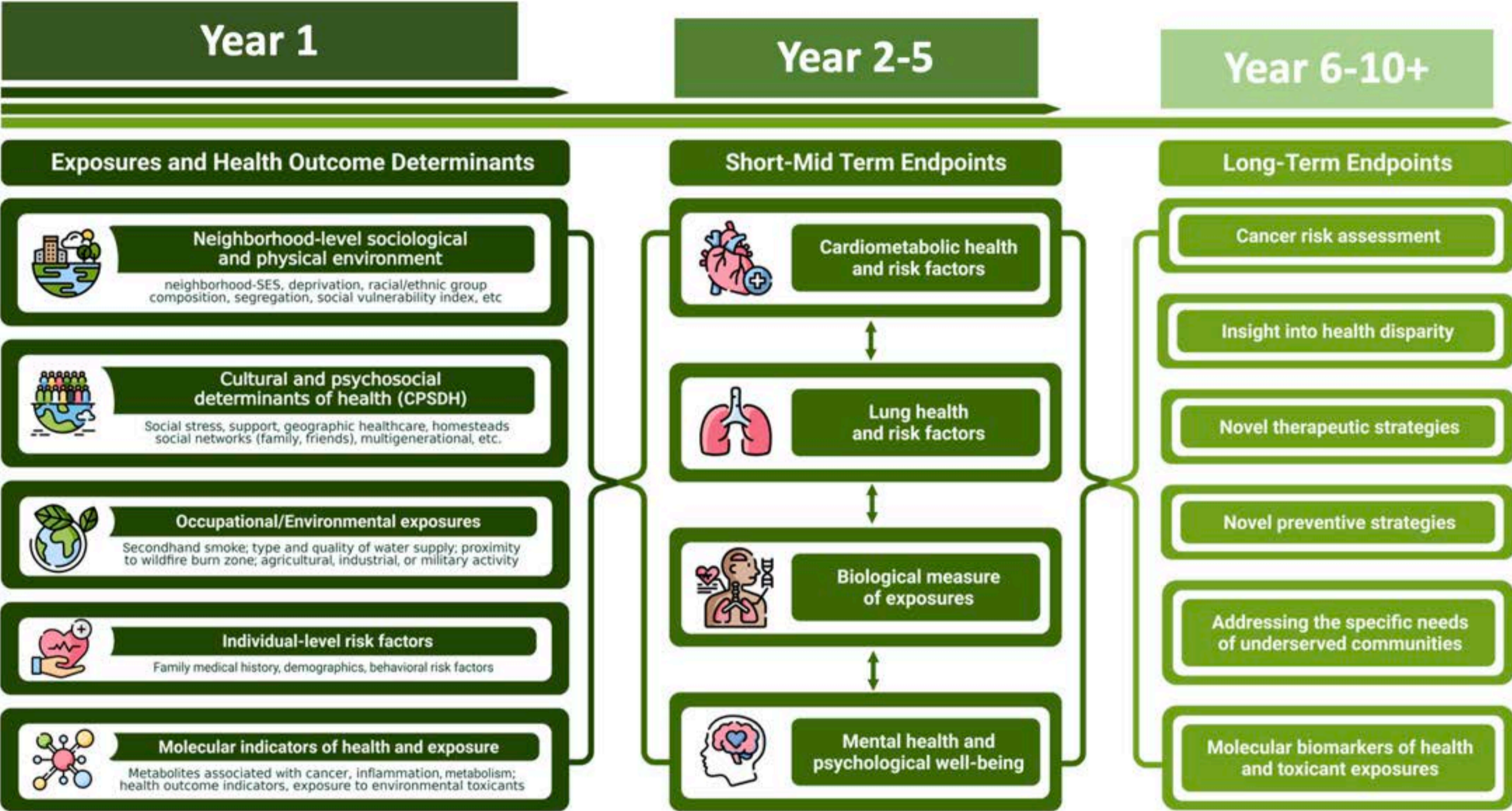


# Maui Wildfire Exposure Study (MauiWES) - Team

## Academic-Community Partnership



# MauiWES - Goals and Timeline



Objective: Establish a cohort of ~1,000 adults impacted by the wildfires to better understand and address short- and long-term health outcomes.

Launch: Data gathering started on January 26, 2024...

# Survey, Biomonitoring, and Health Screening

## Data Components

### Questionnaires

- Demographics
- Housing Stability
- Food Security
- Employment
- Exposure
- Resiliency
- Social Support
- Health Behaviors
- Perceived Trust
- Etc...

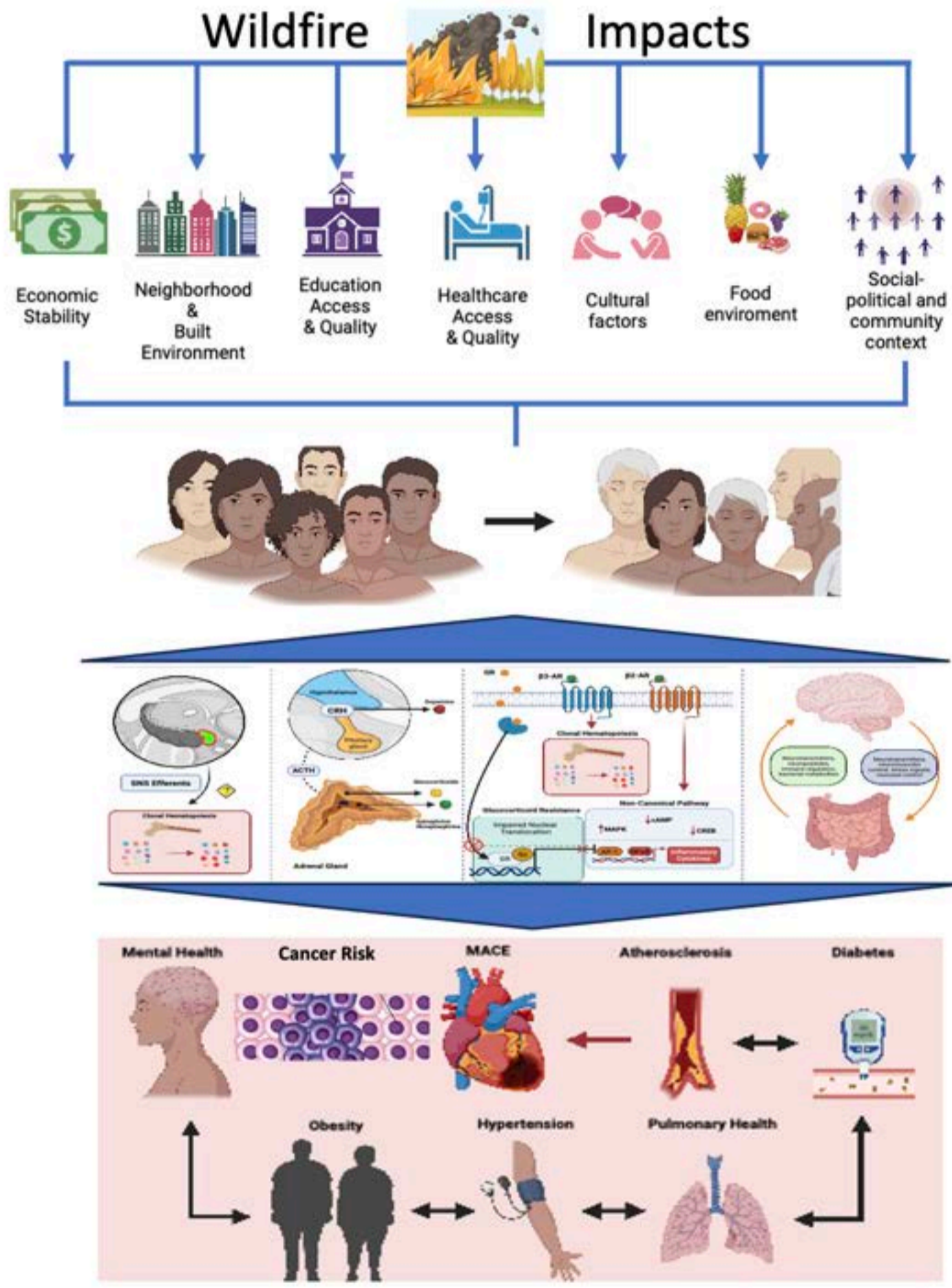
### Biospecimens

- Stress Response
- Inflammation
- Environmental Toxicants

### Health Exam

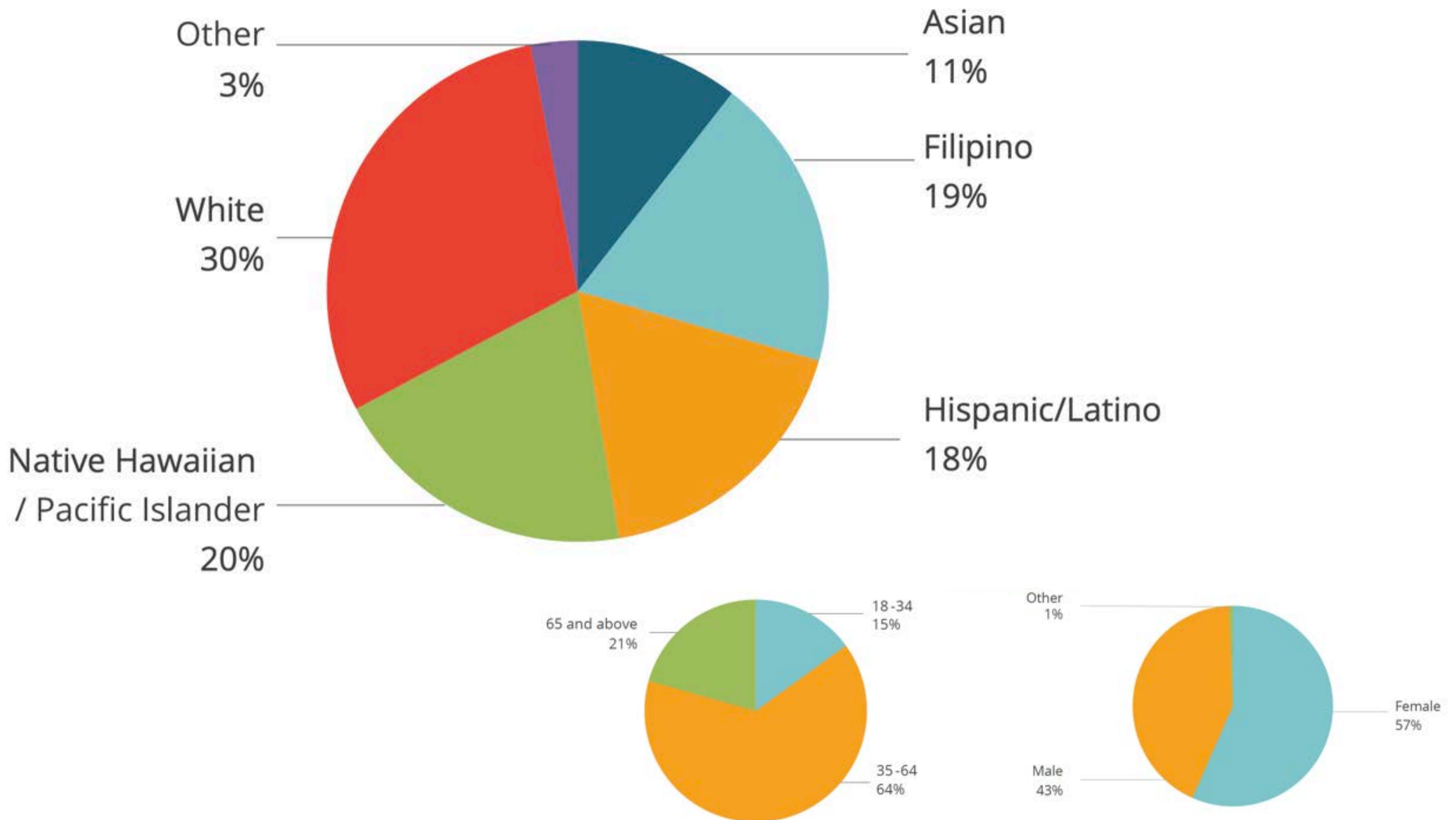
- Lung Health
- Cardiovascular Health
- Metabolic Health
- Mental Health
- Cancer Risk (EMR)

## Participant Involvement



Enrolled: 800+ multiethnic adults to date (~ 16 recruitment days)

# Diverse Cohort Representative of Impacted Population

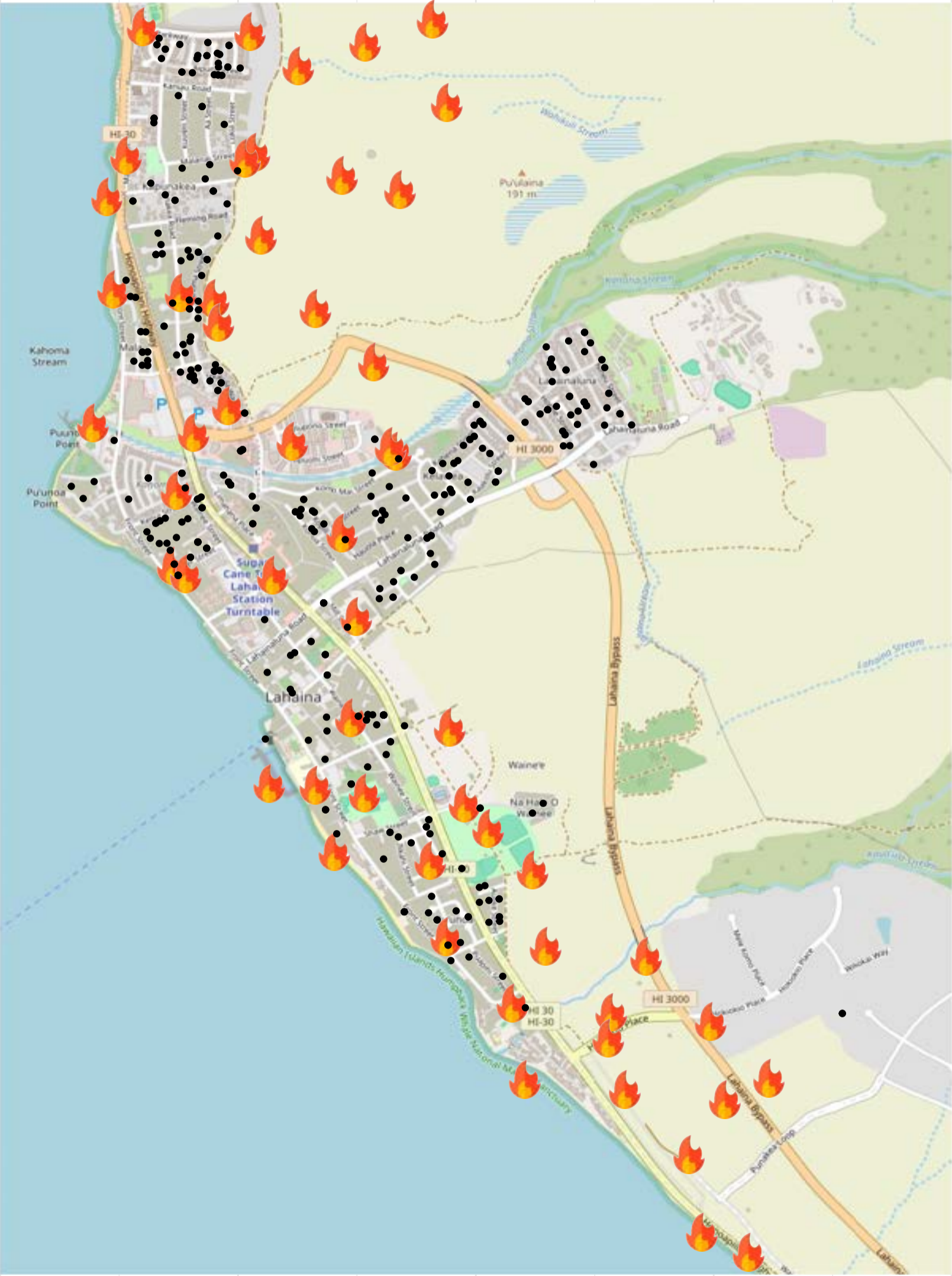


This is the most comprehensive and ethnically diverse study to evaluate short- & long-term health following a natural disaster in Hawai'i.

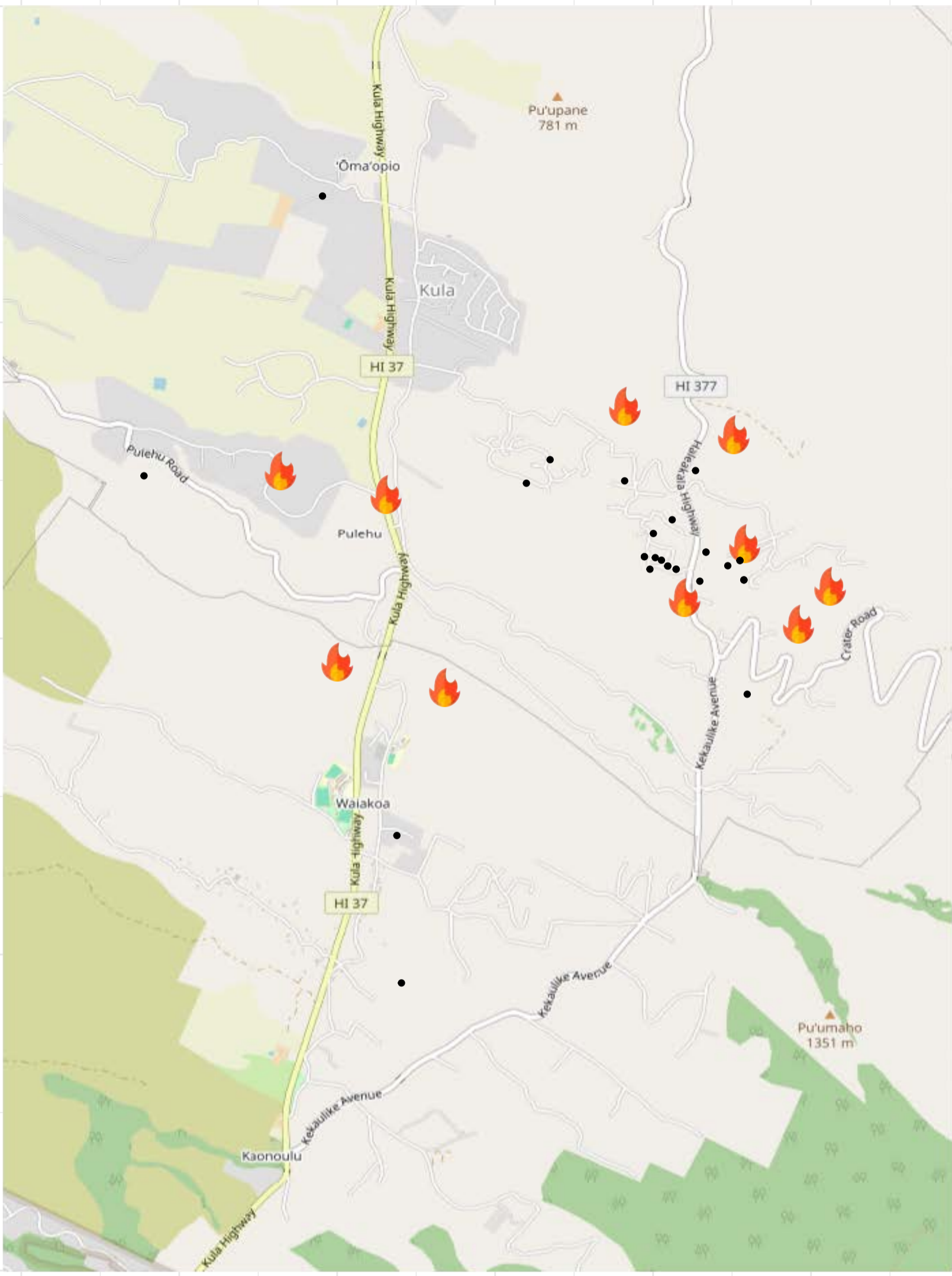


# Broad Residential Representation of MauiWES Cohort

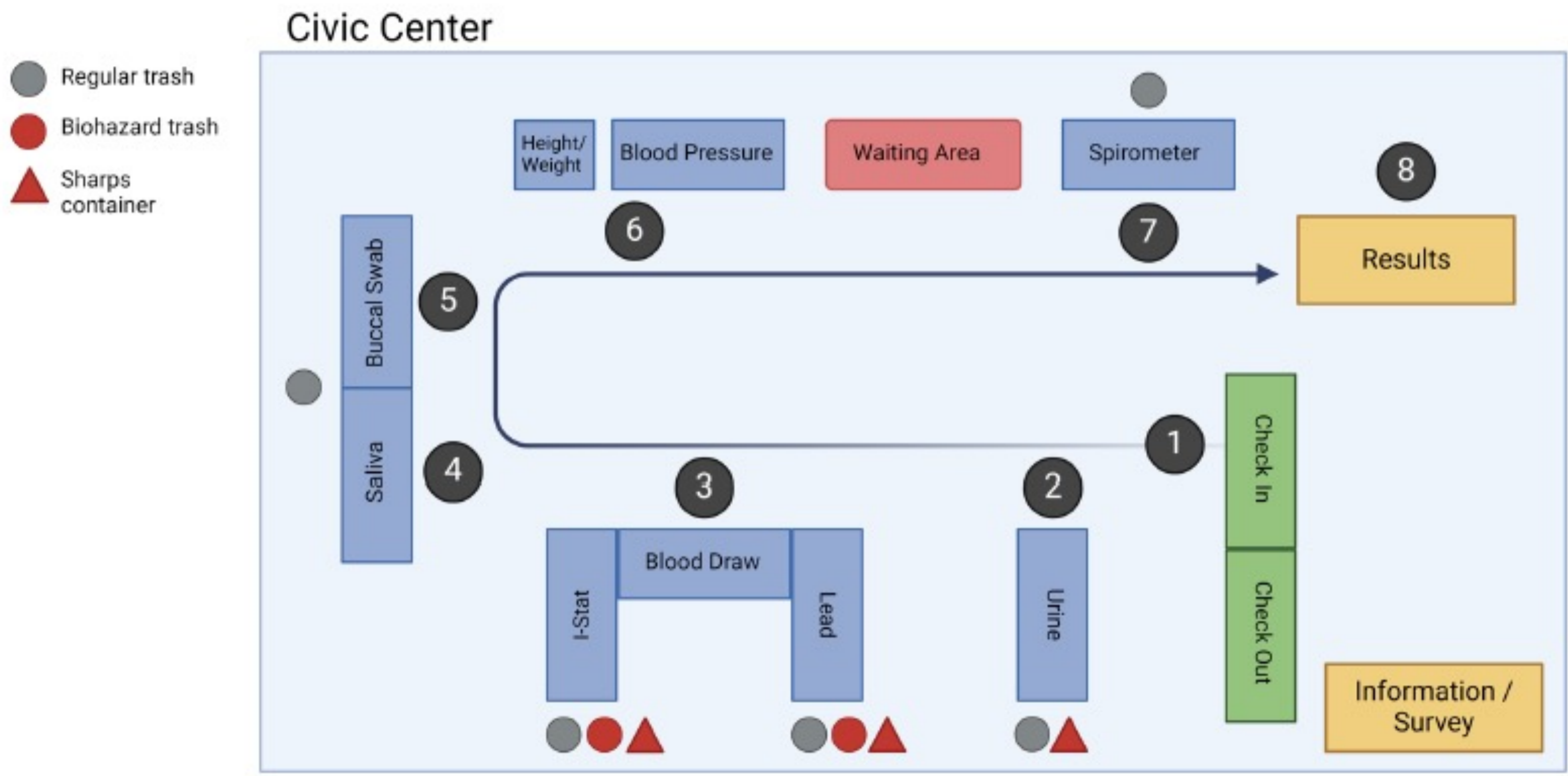
## Lahaina



## Kula




## Pop-up Health Screening Stations





# Example of Participant Results Sheet



**Your Health Statistics Today**

Thank you for participating in Maui Wildfire Exposure Cohort Study, or MauiWES. As part of the study, we collected the following health statistics. Here it is a summary of some of your tests today. Please remember these are not to be used for diagnosis, only for research. We recommend that you follow up with your physician if you have questions about today's results.

**Blood Pressure:**  
 Blood pressure readings fall into four broad categories, ranging from normal to stage 2 high blood pressure (hypertension). The level of your blood pressure determines what kind of treatment you may need. To get an accurate blood pressure measurement, your doctor should evaluate your readings based on the average of two or more blood pressure readings at three or more office visits.

Your Blood Pressure Today was Systolic: \_\_\_\_ (mm Hg) and Diastolic \_\_\_\_ (mm HG)

Top number (systolic)	Bottom number (diastolic)	Your category
Below 120	and Below 80	Normal Blood Pressure
Between 120-139	or Between 80-89	Prehypertension
Between 140-159	or between 90-99	Stage 1 hypertension
160 or more	or 100 or more	Stage 2 hypertension

**Spirometer:**  
 A spirometer is a device used to measure the amount of air you can breathe in and out. It helps assess your lung function. The main test we are focusing today is the Forced Vital Capacity. This test focuses on how much air you can forcefully exhale after taking a deep breath. It provides valuable information about your lung health and can help detect respiratory problems. Your Forced Vital Capacity is \_\_\_\_ liters.  
 Category:  Normal.  Low.  
 Normal values in healthy patients aged 20-60 range from 5.5 to 4.75 liters in males and from 3.75 to 3.25 liters in females.

**Blood Tests:**  
 The blood tests today were performed with the iStat system by Abbot. The i-Stat system is a portable device used for on-the-spot blood testing. It's like a mini laboratory that can analyze small amounts of blood to give immediate results. It works with different cartridges that perform different tests. We are running two cartridges, CG4+ and CHEM8+. The CG4 cartridge is specifically designed to measure blood gases and electrolytes, while the CHEM8 cartridge focuses on a broader range of tests related to blood chemistry. The main results we would like to share with you are:  
 Glucose: \_\_\_\_\_. Category:  Normal.  Low.  High.  
 Normal Range: Less than 140 milligrams per deciliter (mg/dL) or less than 7.8 millimoles per liter (mmol/L). Levels above 300mg/dl or below 70mg/dl are concerning. Glucose is a type of sugar that our bodies use as a source of energy. It comes from the food we eat, especially carbohydrates. Keeping blood glucose levels in balance is crucial. If levels are too high (hyperglycemia) or too low (hypoglycemia), it can cause health problems. Chronic high blood sugar levels, specifically, can lead to conditions like diabetes.

Creatinine: \_\_\_\_\_. Category:  Normal.  High.  
 Normal range: 0.6 to 1.2 milligrams per deciliter (mg/dL). High creatinine levels can indicate a range of underlying health conditions, including kidney infection and kidney failure. Doctors typically consider high creatinine levels to be above 1.2 milligrams per deciliter (mg/dL) for males and 1.0 mg/dL for females.

Lactate: \_\_\_\_\_. Category:  Normal.  High.  
 A normal blood lactate level is 0.5-1 mmol/L. An increase in lactate production is typically caused by impaired tissue oxygenation, either from decreased oxygen delivery or a disorder in oxygen use. It can be an indicative of severe lung disease, respiratory failure, or pulmonary edema.




Today we collected various data points, **Including:**

- Height
- Weight
- Spirometer readings
- CG4+
- CHEM8+
- Blood
- Urine
- Saliva
- Cheek swabs.

This data will be used for a range of tests, and the results will be made available to you on your personal dashboard as soon as they are ready. You are welcome to share your data with your medical provider if you have any questions or concerns.

**What can you expect?**  
 Within the next 7 days, your **dashboard profile** will be accessible, and we will continue to update it with new data as it becomes available. Every time it is updated, **we will notify you via email.**

The Hawai'i CARES line Available 24/7 Call or Text 988  
 Replacement of vital records Including birth and marriage certificates vitrec.chawaii.gov  
 For more resources, please go to: [health.hawaii.gov/mauiwildfires](http://health.hawaii.gov/mauiwildfires)

To log-in to your online data dashboard visit [hia.llc/login](http://hia.llc/login) or scan the QR code below.

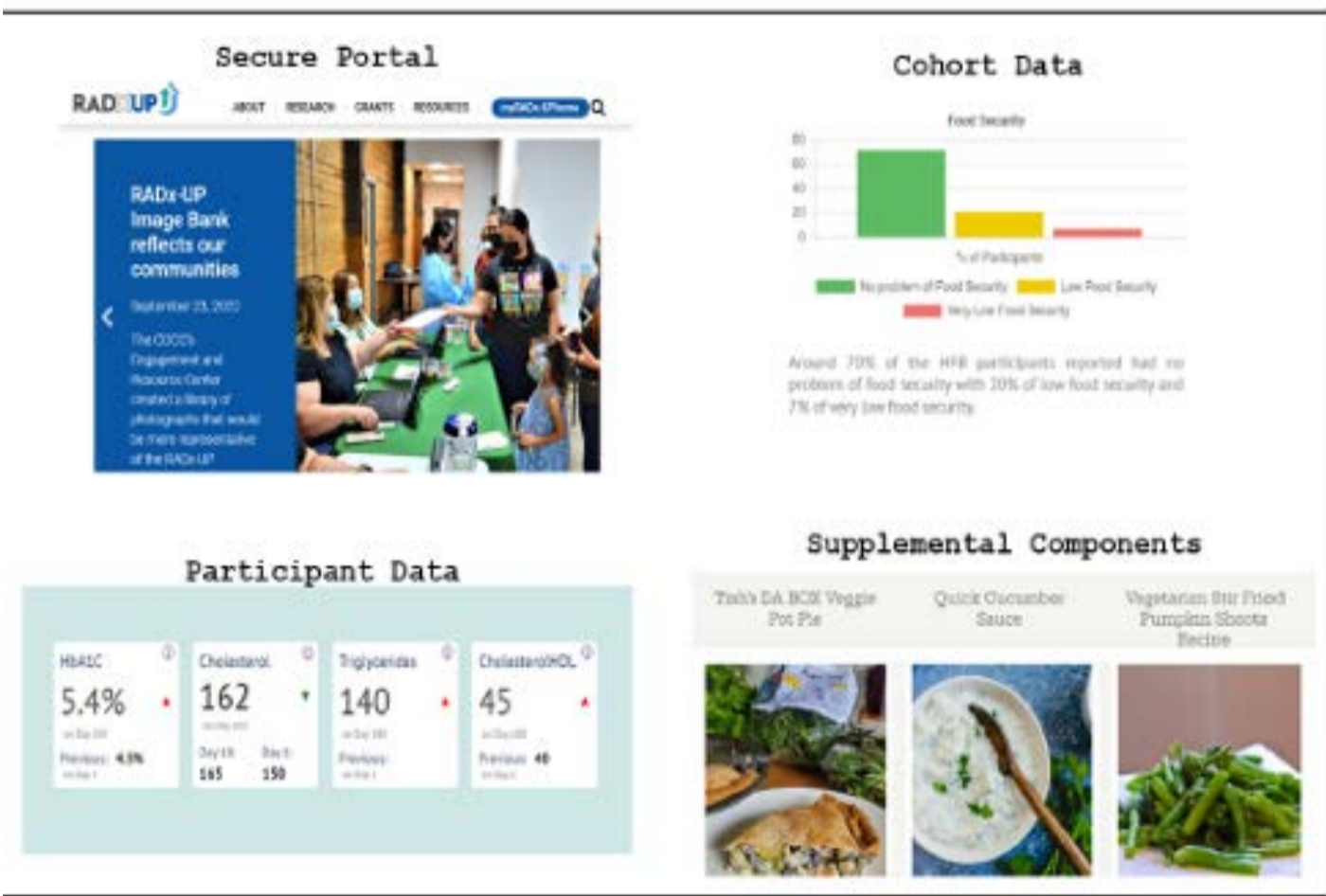


Additional resources will be added to your dashboard in the future. If you have any questions, please feel free to email us at [MauiWES@hawaii.edu](mailto:MauiWES@hawaii.edu).

Thank you for your participation in this study. We appreciate your contribution.

# Dissemination - Participant Data Portal and Dashboard

- Participants are provided with RAPID results for relevant health conditions and some environmental hazard exposures with more comprehensive tests to be analyzed later



- We will connect participants to their results and at-risk individuals will be referred to relevant services/providers using a *de novo* Wildfire Exposures Data Dashboard



# MauiWES Main Findings to Date

Independent **UHERO**  
**Public Health Report &**  
**the most**  
**comprehensive Data**  
**Dashboard** of the  
disaster: [MauiWES.info](https://mauiwes.info)



## Main trends detailed in the report:

1. Mental and physical health issues
2. Access to care
3. Housing, job, and food insecurity



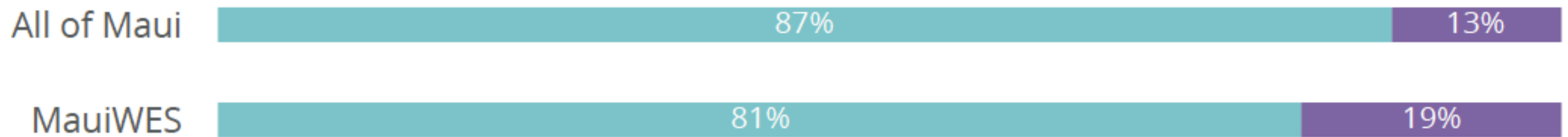
# Postfire Declines in Mental Health

Alarming rates of mental health issues among survivors: 52% of participants showed depressive symptoms, 19% reported low self-esteem, 30% had moderate to severe anxiety, and 4.4% had considered suicide in the past month.

## Depression



## Self-esteem

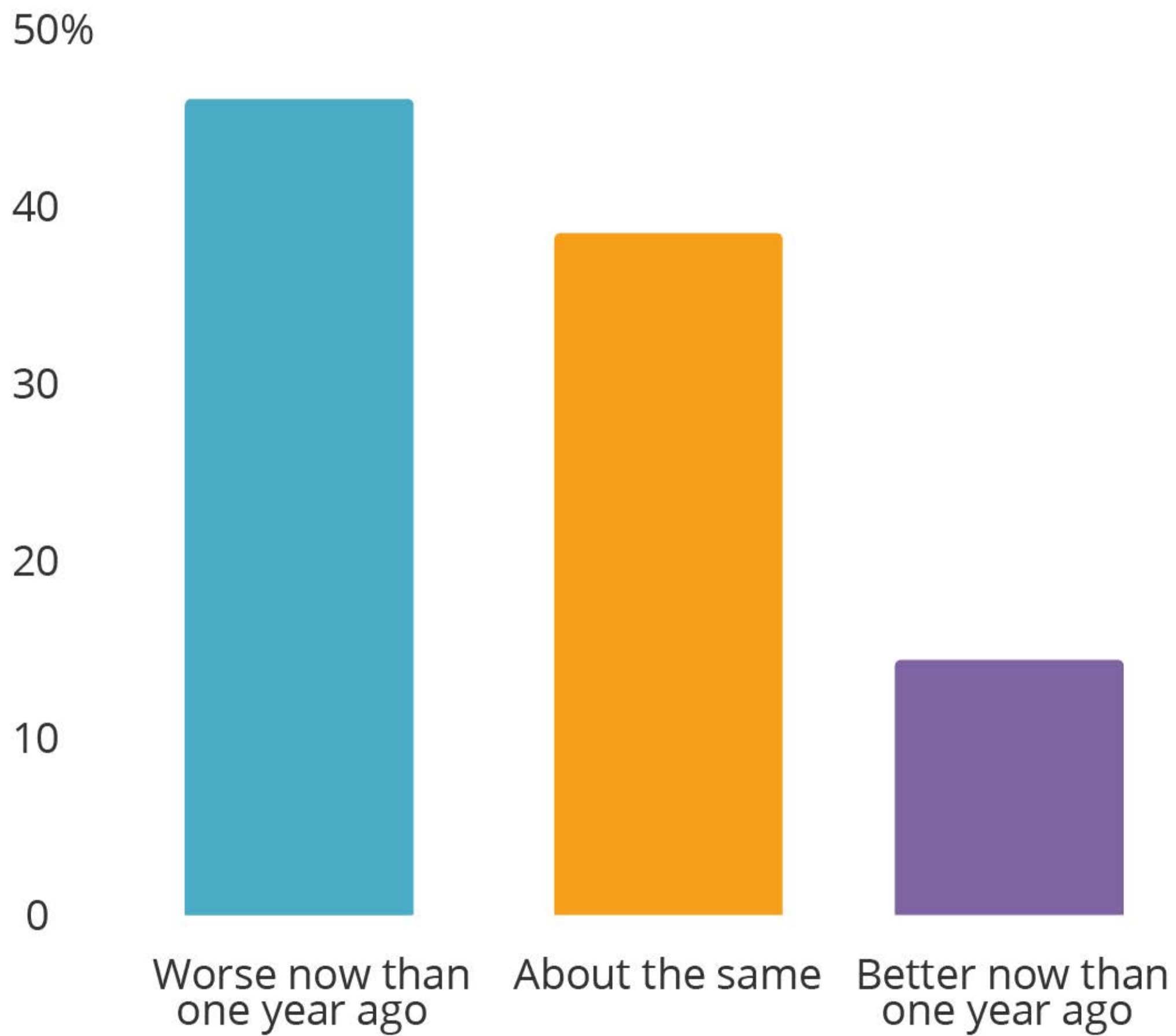


## Suicidal ideation



# Postfire Declines in Physical Health

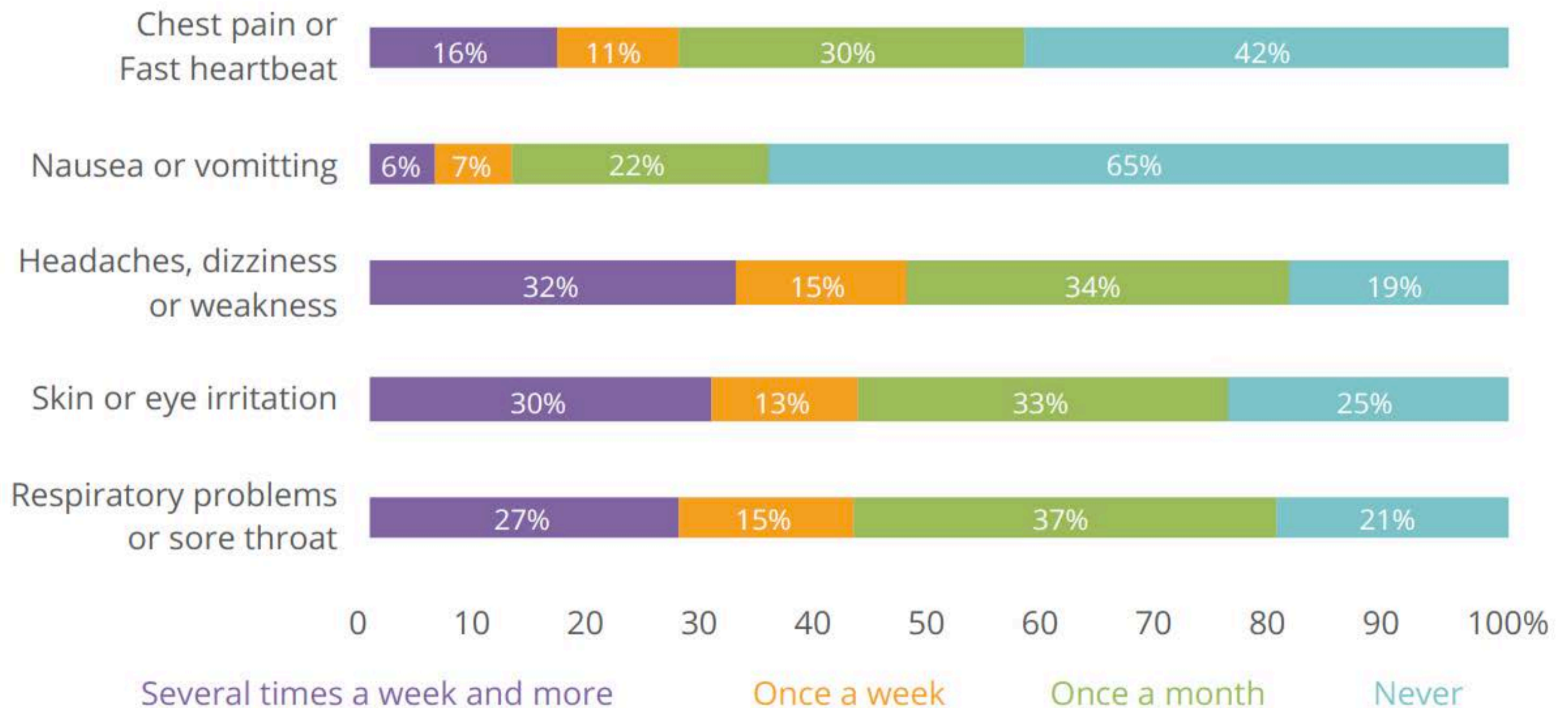
Nearly half of the participants reported worsened health since the wildfires, particularly among those with higher exposure to wildfire ash, debris, and smoke.



# Symptoms & Health Screenings Validate Self-reports

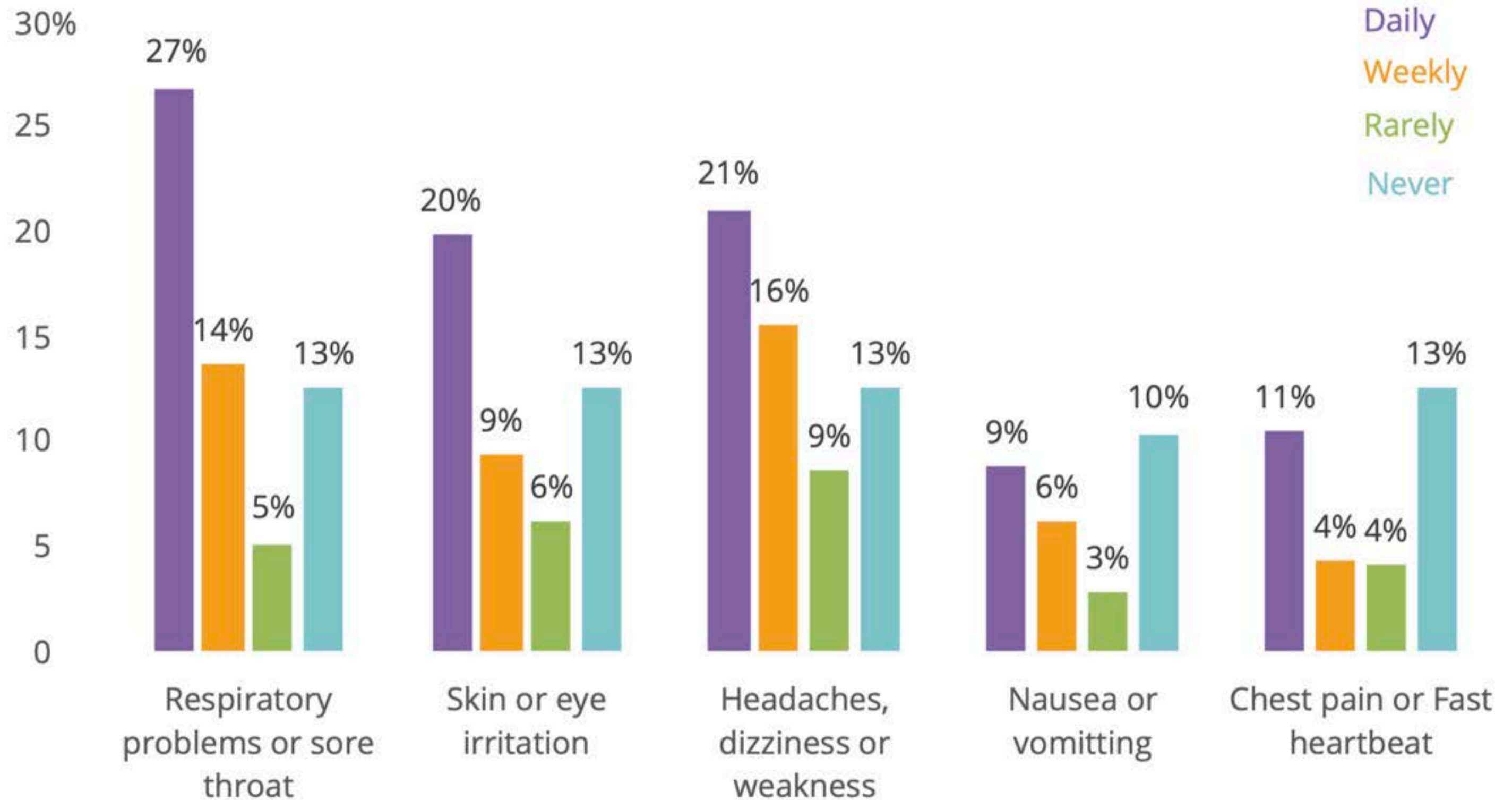
Respiratory issues (coughing, wheezing, difficulty breathing), skin/eye irritation, fatigue or weakness are the most common symptoms reported among participants.

How often have you experience the following symptoms since the wildfires?



# Self-reported Exposure Associates with Symptoms

Percentage of responses of "Always/ Frequently" experiencing the symptoms since wildfires by the exposure to wildfire debris, smoke or ash



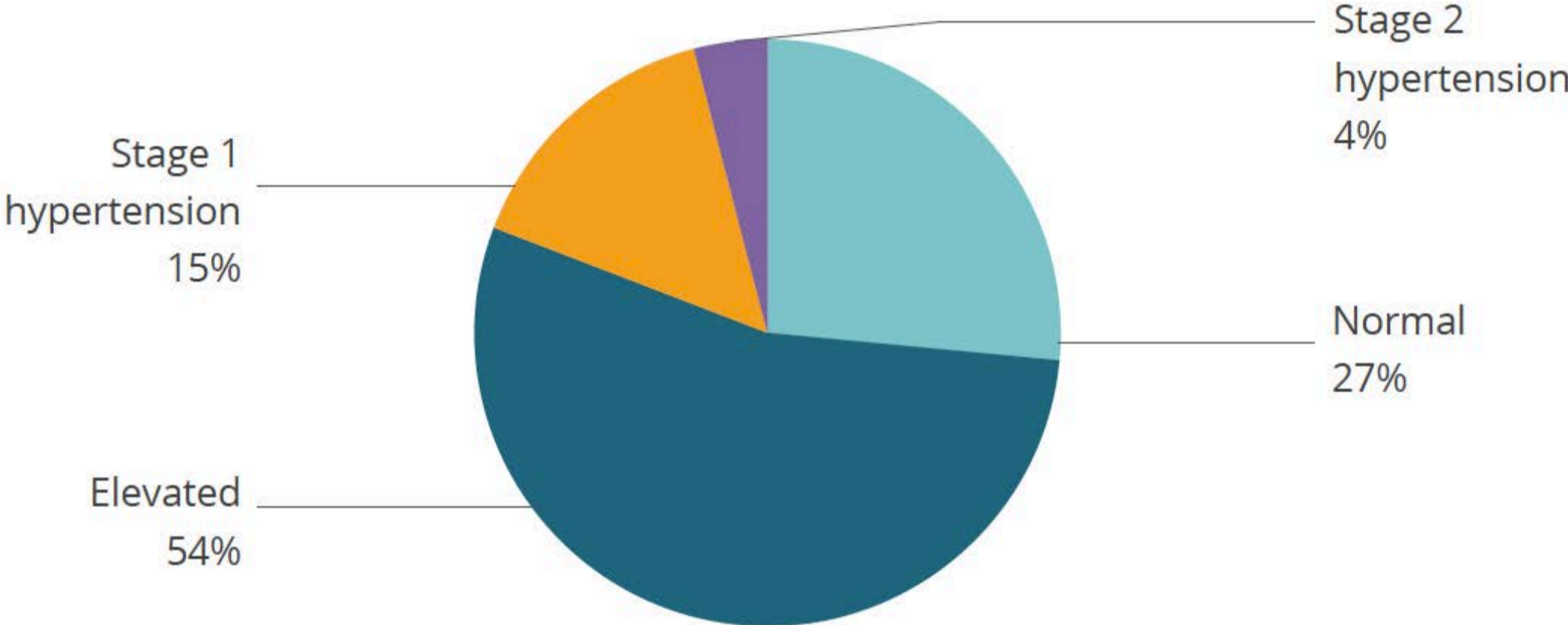
*Individuals who reported frequent exposures to wildfire debris, smoke, and ash tended to experience more symptoms*



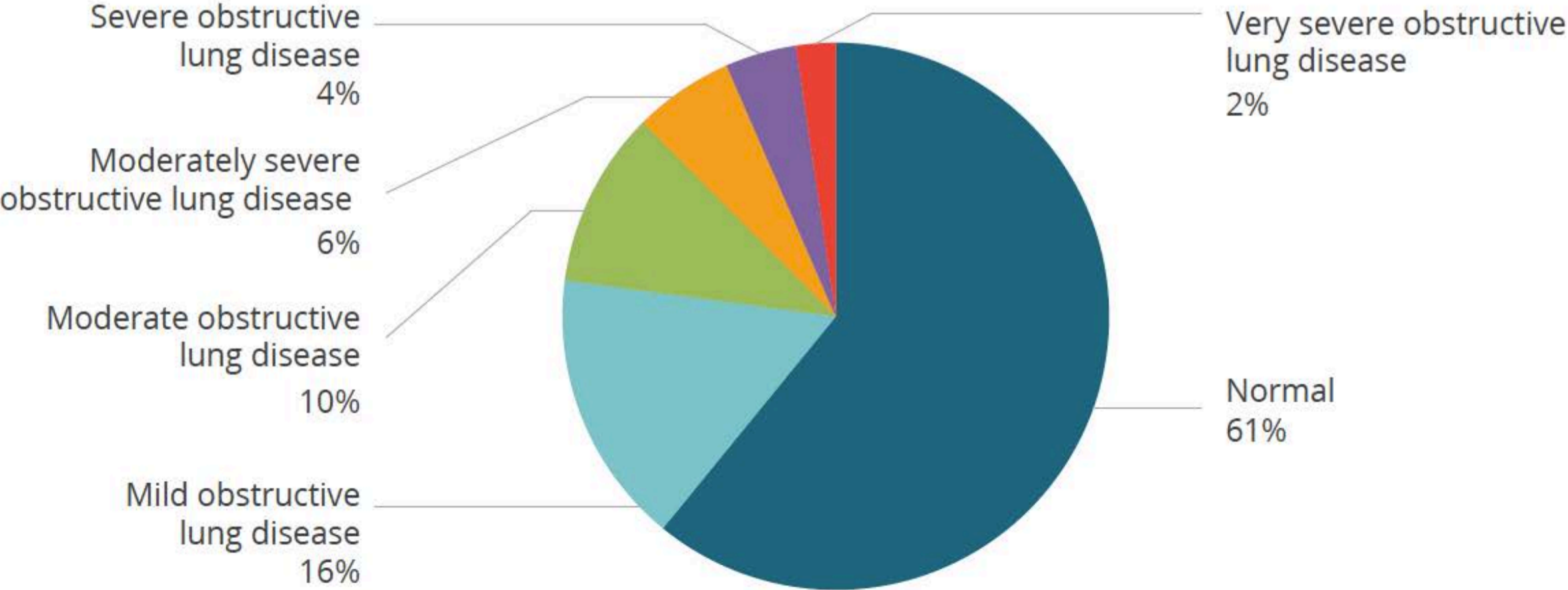
# Prevalence of Cardiopulmonary Risk

~74% of participants face a heightened risk of cardiovascular disease due to high blood pressure at elevated to hypertension levels. Up to 60% may suffer from poor lung health based on spirometry measures, with 40% with mild to severe lung obstruction.

Blood Pressure Categories



FEV1 Category

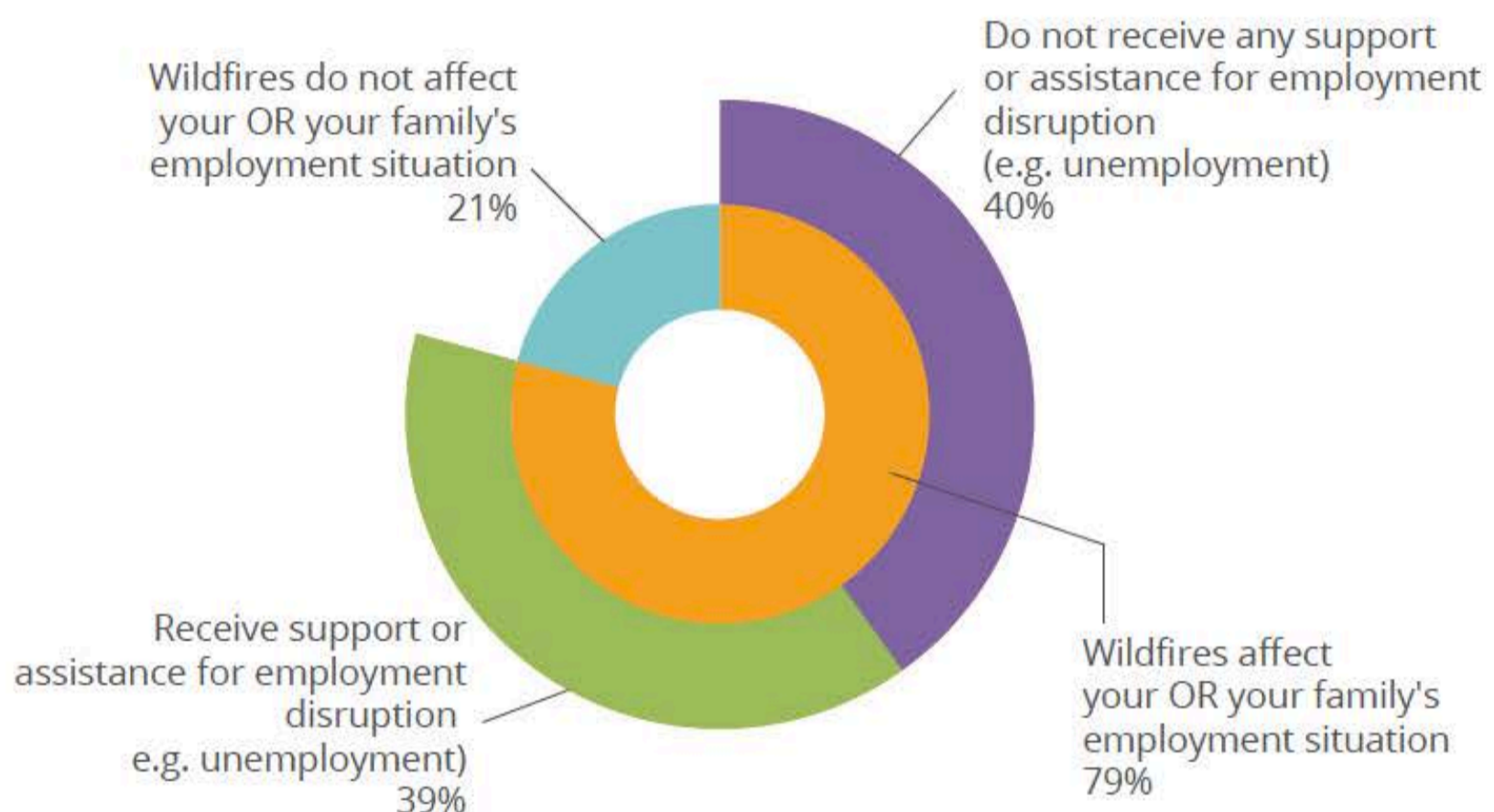




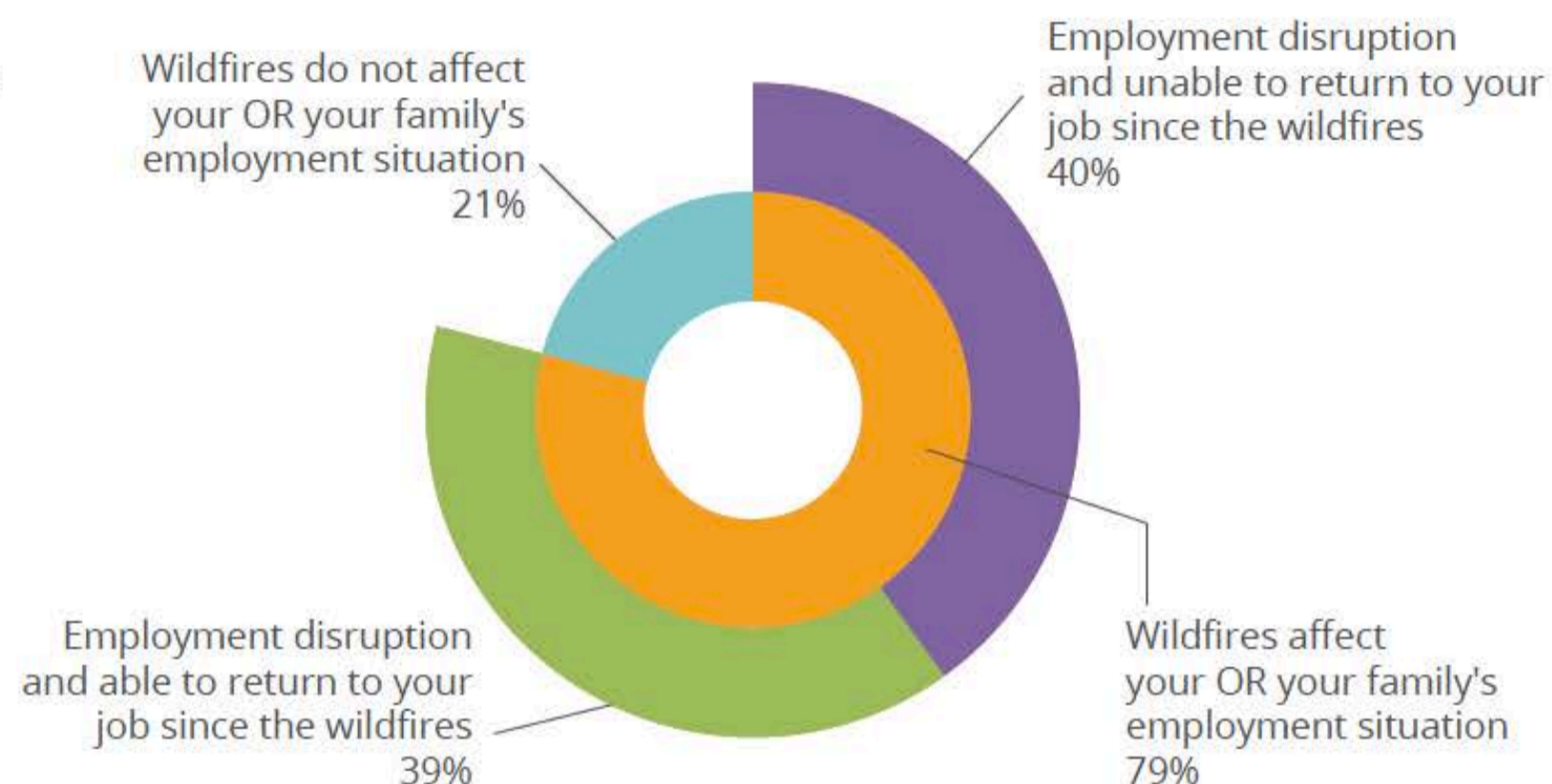
# Postfire Job/Income Loss

Over 70% of MauiWES participants reported loss of income after the fires, with about 1/3 reporting job loss and looking for employment.

Did the wildfires affect your OR your family's employment situation? Did you receive support or assistance for employment disruption (e.g., unemployment)?



Did the wildfires affect your OR your family's employment situation? Have you been able to return to your job since the wildfires?

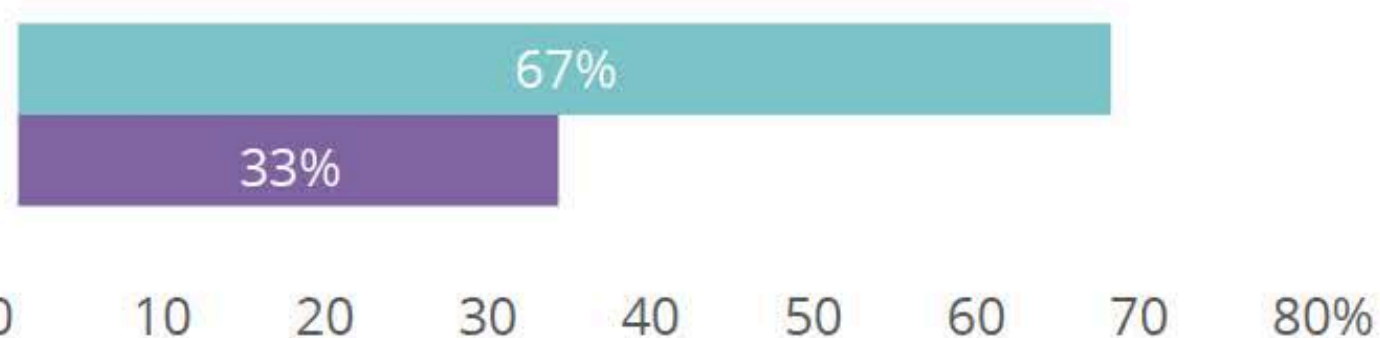


## Employment effect of wildfires

Have you or your household experienced a decrease in income following the wildfires?



Are you currently looking for work due to changes in your employment caused by the wildfires?

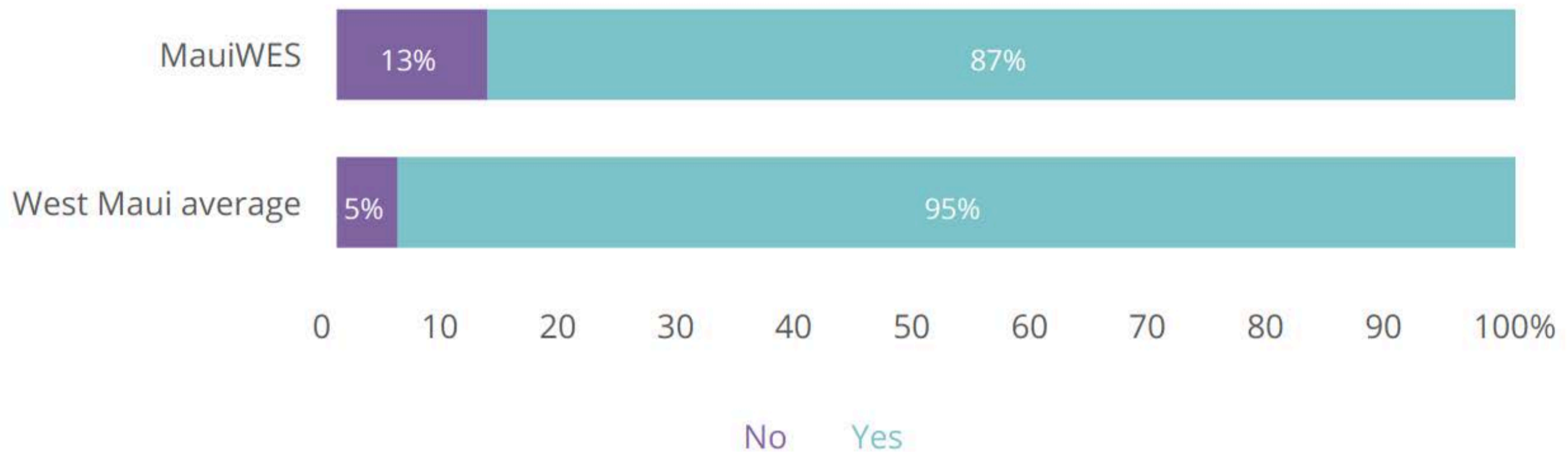


0 10 20 30 40 50 60 70 80%

# Postfire Loss of Health Insurance Coverage

Significant disparities in health insurance coverage were also found, with over 10% of participants lacking insurance, notably more than 30% among Hispanics.

Do you currently have health insurance?



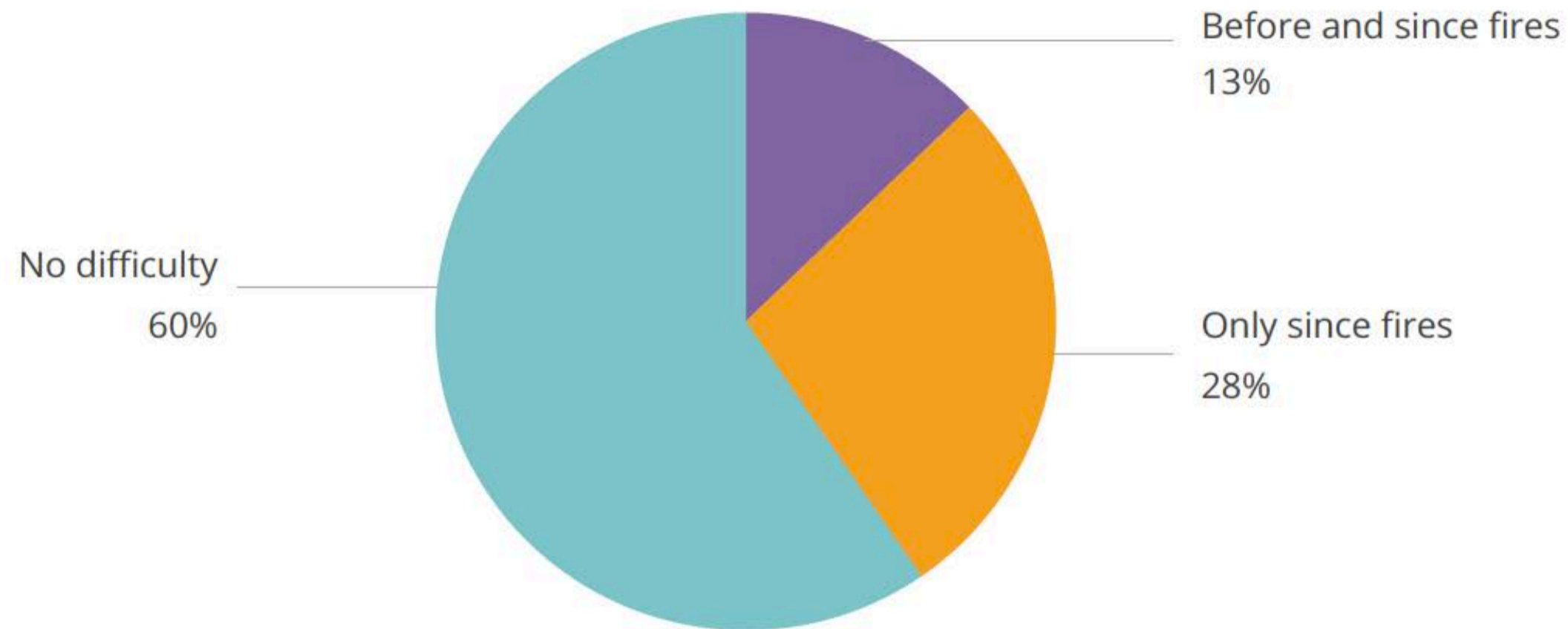
Do you currently have health insurance?



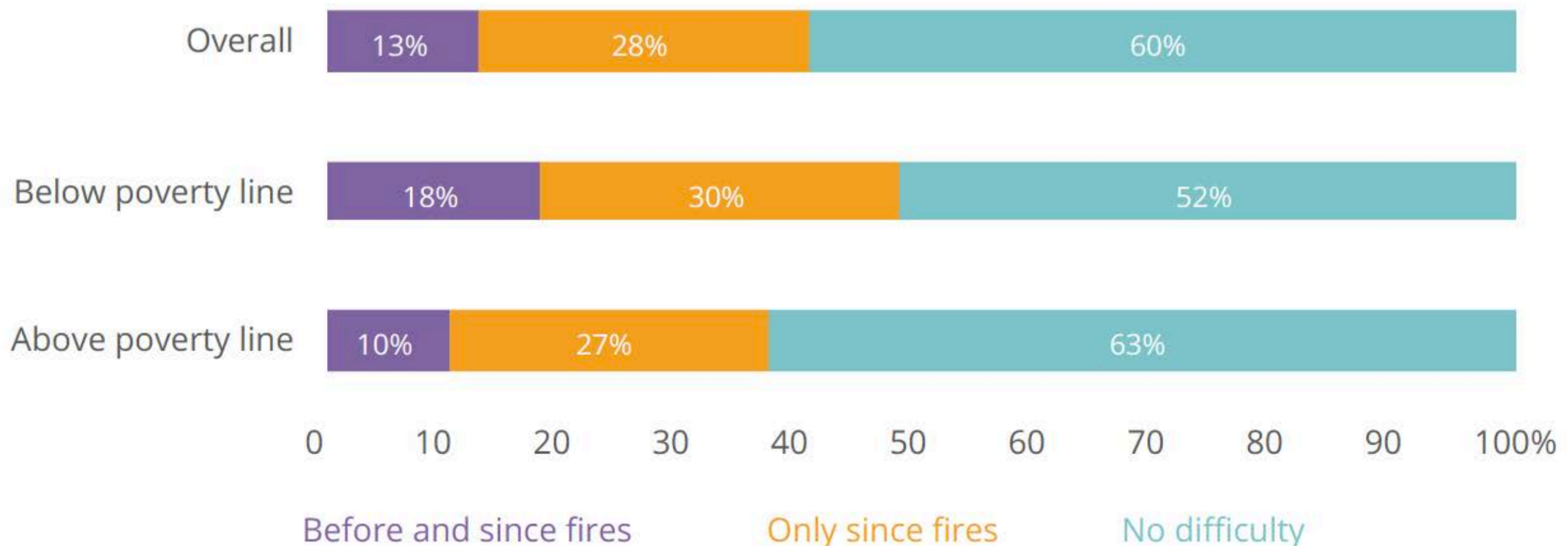
# Increased Difficulty in Accessing Medical Care

~ 4/10 people in the MauiWES cohort report having trouble getting medical care and medications, compared to ~ 1/10 before the fires.

Did you have any difficulties accessing medical care or medications?

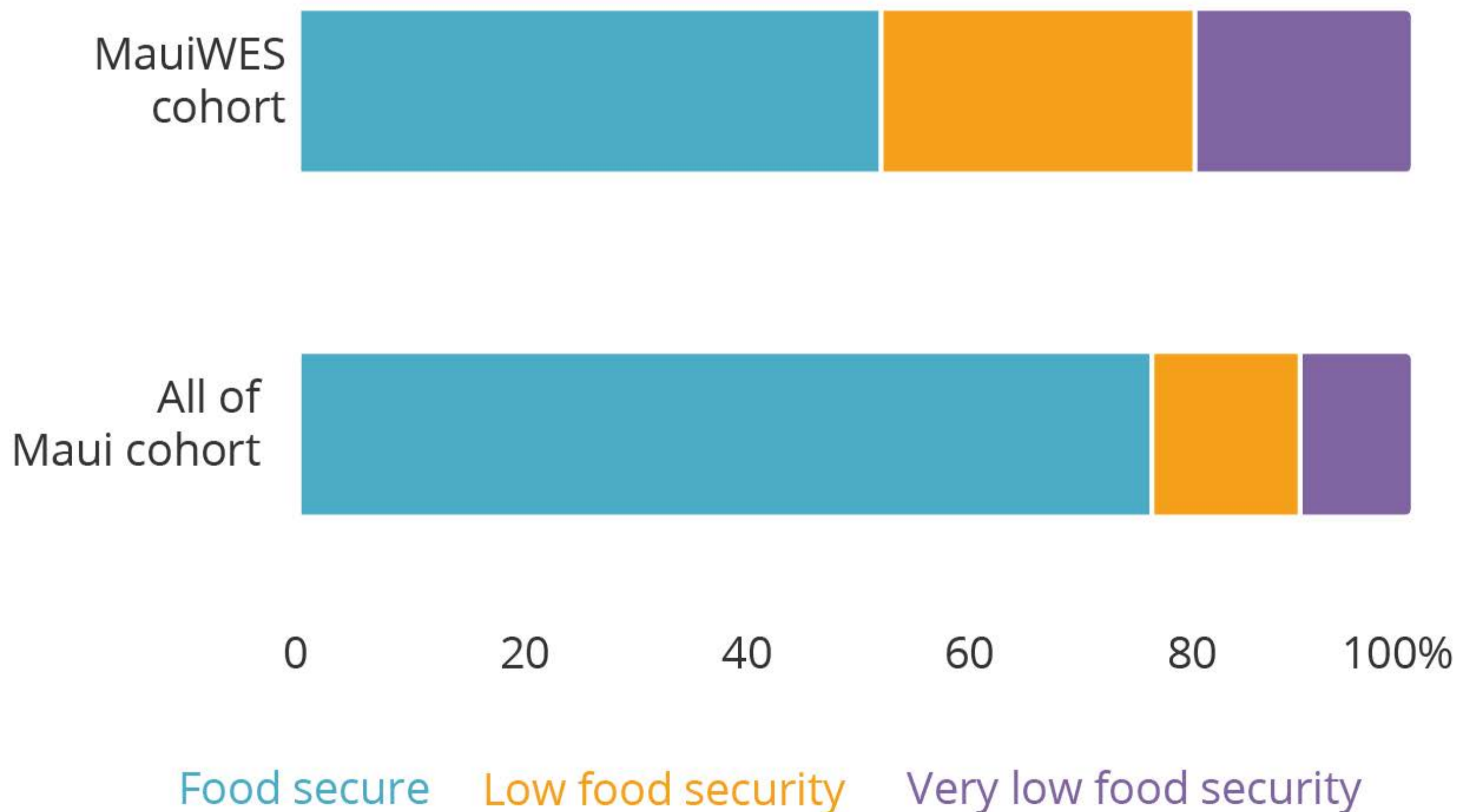


Did you have any difficulties accessing medical care or medications? - by poverty line



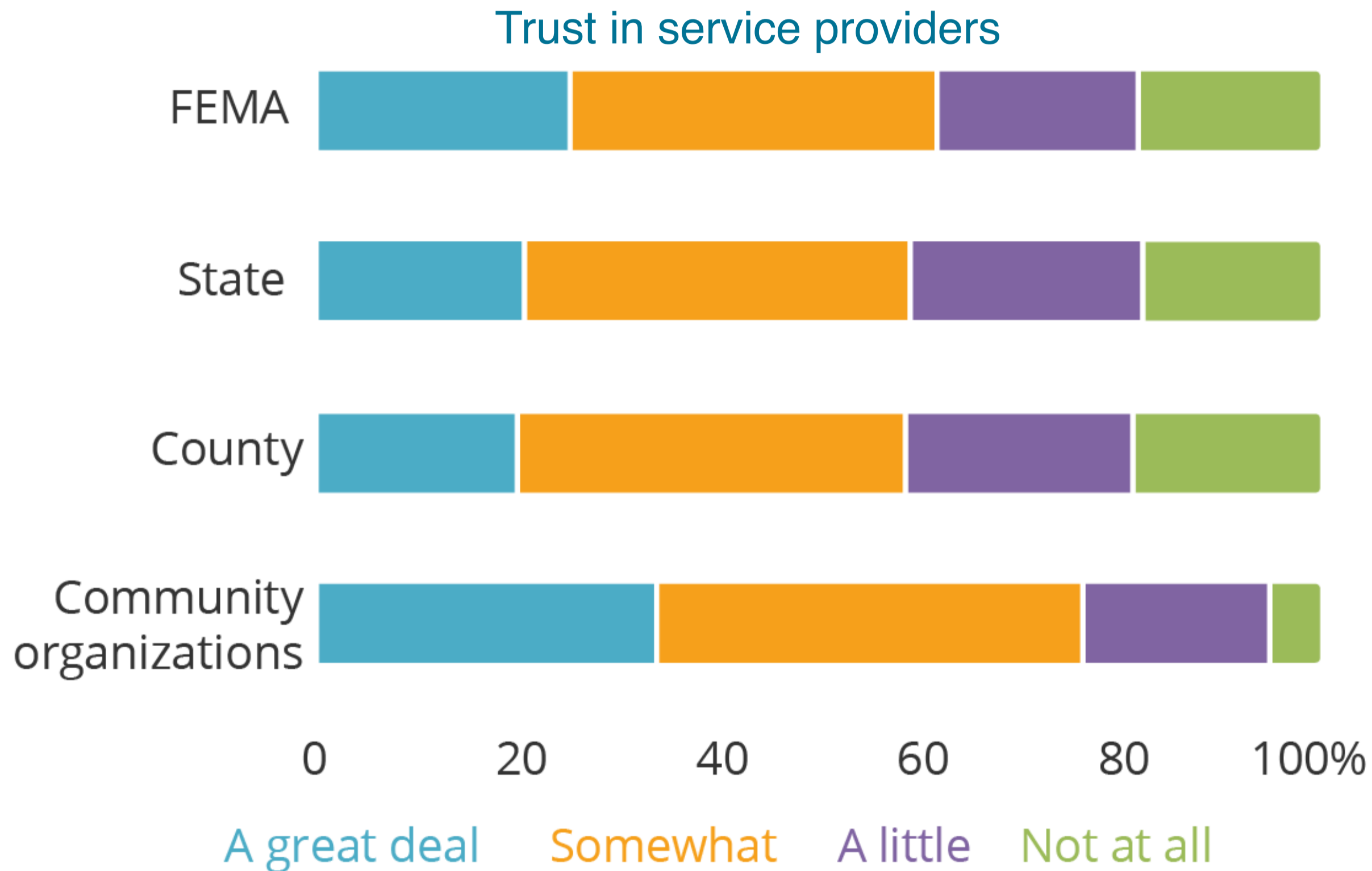
# Increased Food Insecurity

Almost half of respondents experienced very low or low food security. This is substantially higher than in the pre-fire UHERO Rapid Survey cohort for all of Maui where less than a quarter of participants were found insecure.



# Resiliency - Trust and Social Connectedness

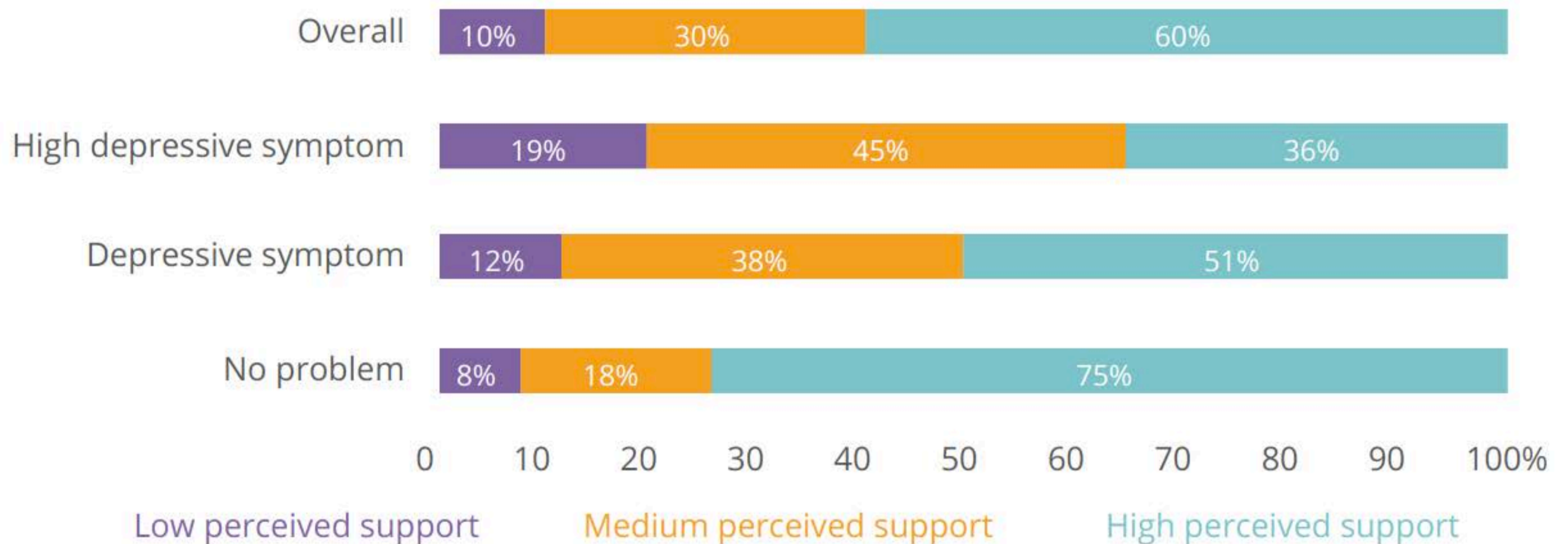
MauiWES participants trust and use community organizations more than FEMA or local government services for wildfire aid.



# Resiliency - Trust and Social Connectedness

Participants reporting high levels of perceived social support tend to have less depressive symptoms than those reporting low levels of perceived social support who also tend to experience more difficulties accessing care.

Multidimensional Scale of Perceived Social Support by depression



# Inductively Coupled Plasma-Tandem Mass Spectrometry of Urine Samples for Heavy Metal Exposures

The ash samples were collected on November 7-8, 2023 from 100 properties in Lahaina, which had been constructed from the 1900s to the 2000s.

Parameter	Unit	Lab Report #1	Lab Report #2	Lab Report #3	Mean Lab Reports	Soil Environmental Action Level
Arsenic	mg/kg	297	269	275	280	23
Lead	mg/kg	383	416	431	410	200
Antimony	mg/kg	26	24	26	25	6.3
Cobalt	mg/kg	27	23	26	25	4.7
Copper	mg/kg	1,400	1,970	1,630	1,667	630



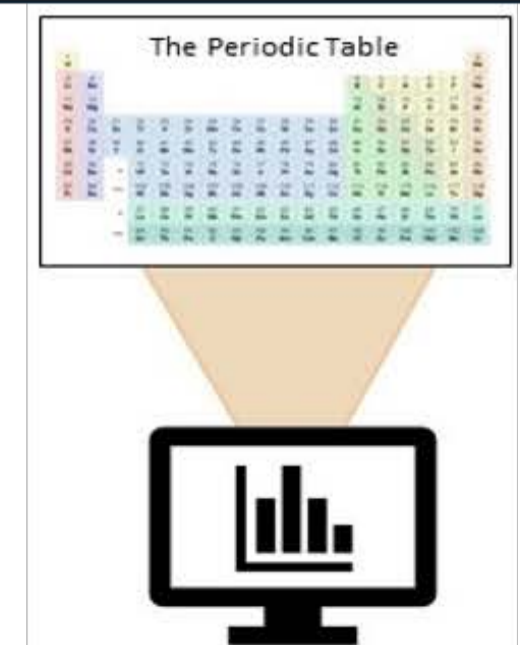
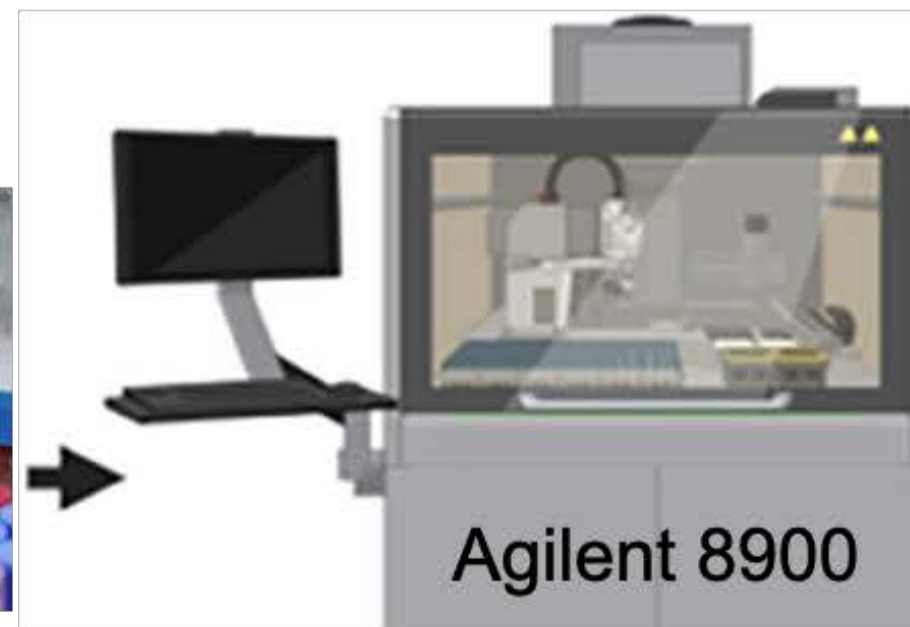
**33 elements: Li, Mg, Al, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Br, Se, Sr, Mo, Ru, Pd, Cd, Sn, Sb, Cs, Ba, Tb, W, Re, Hg, Tl, Pb, Bi, U**

Urine Sample

Sample Processing

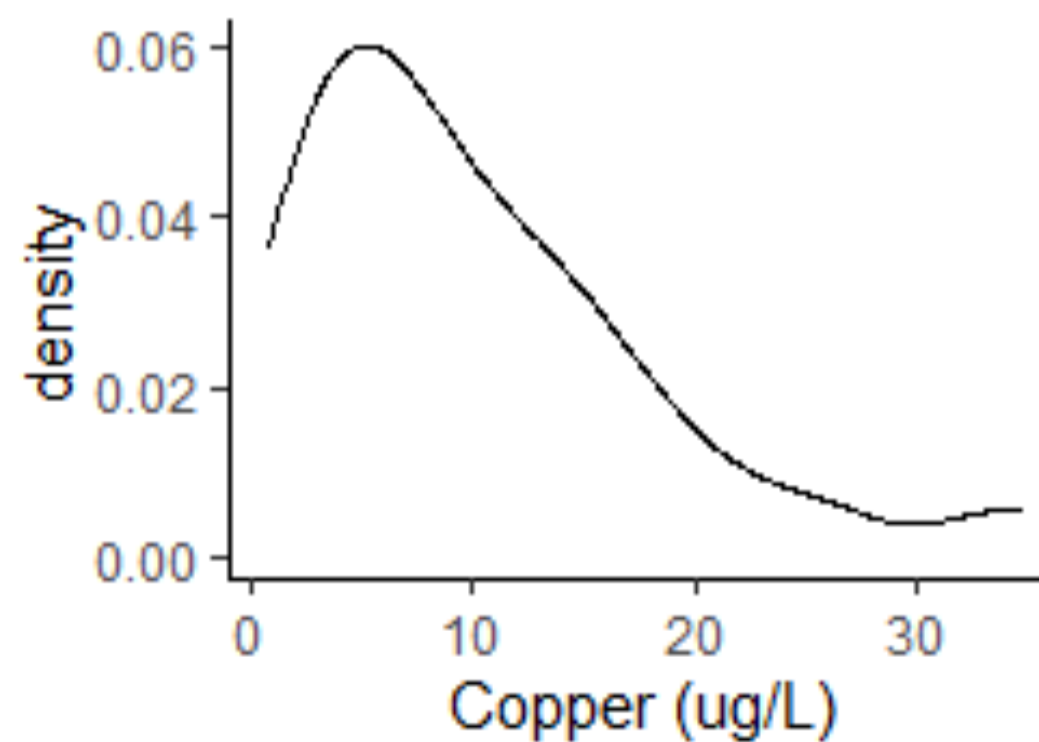
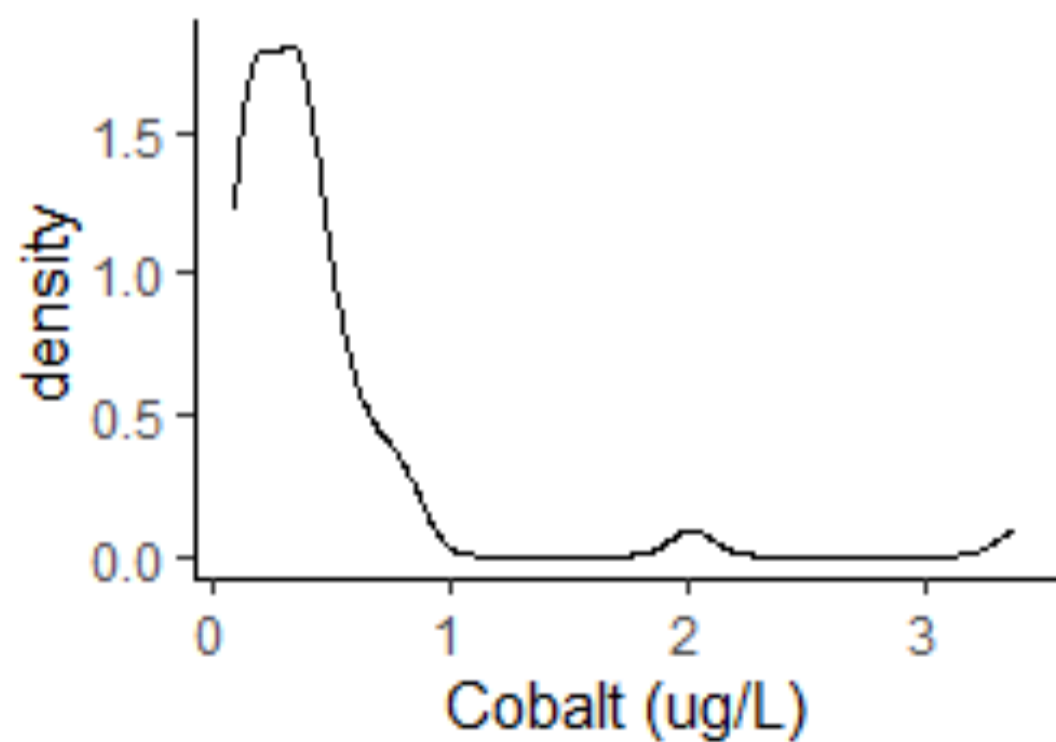
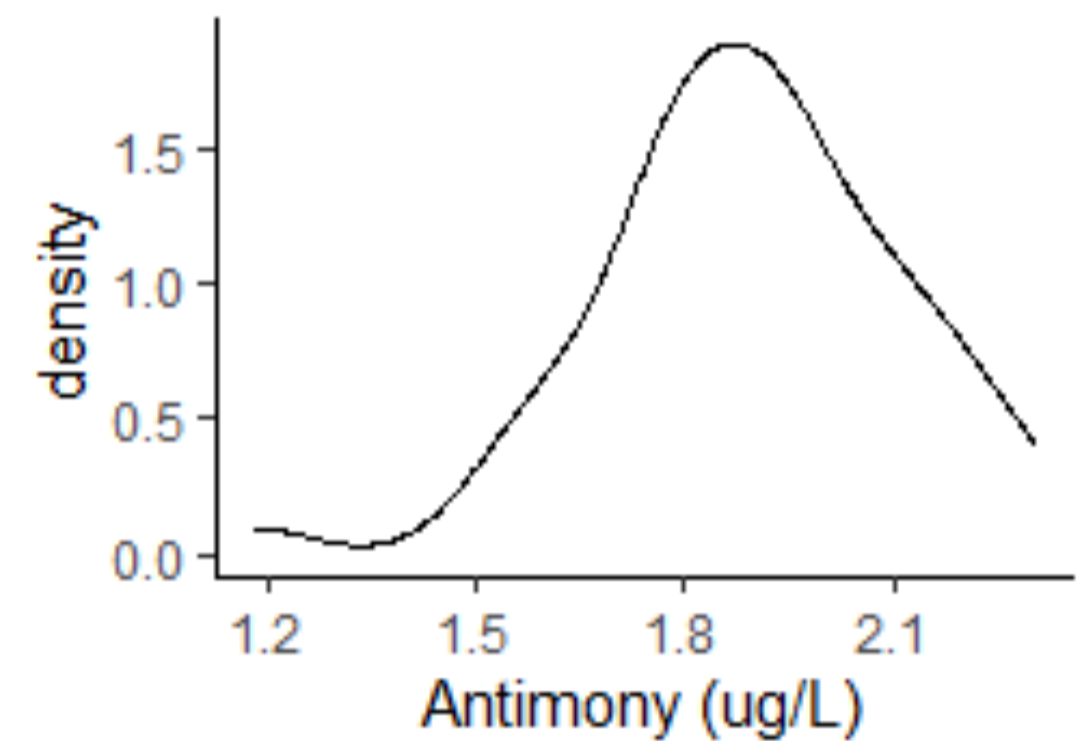
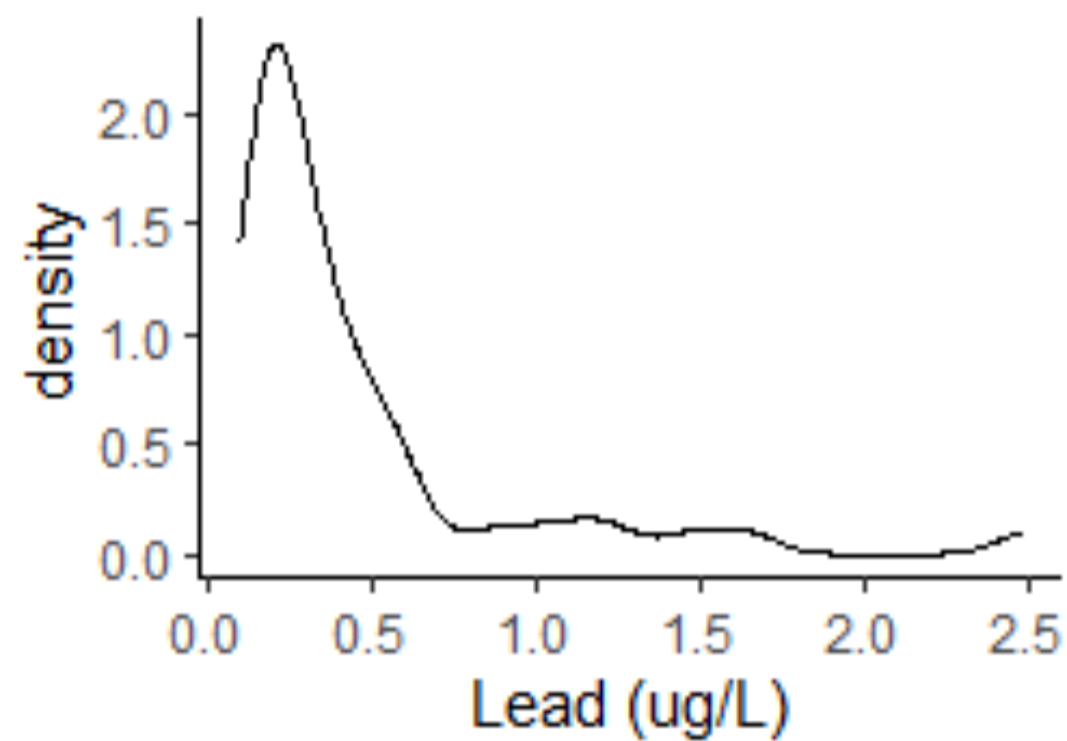
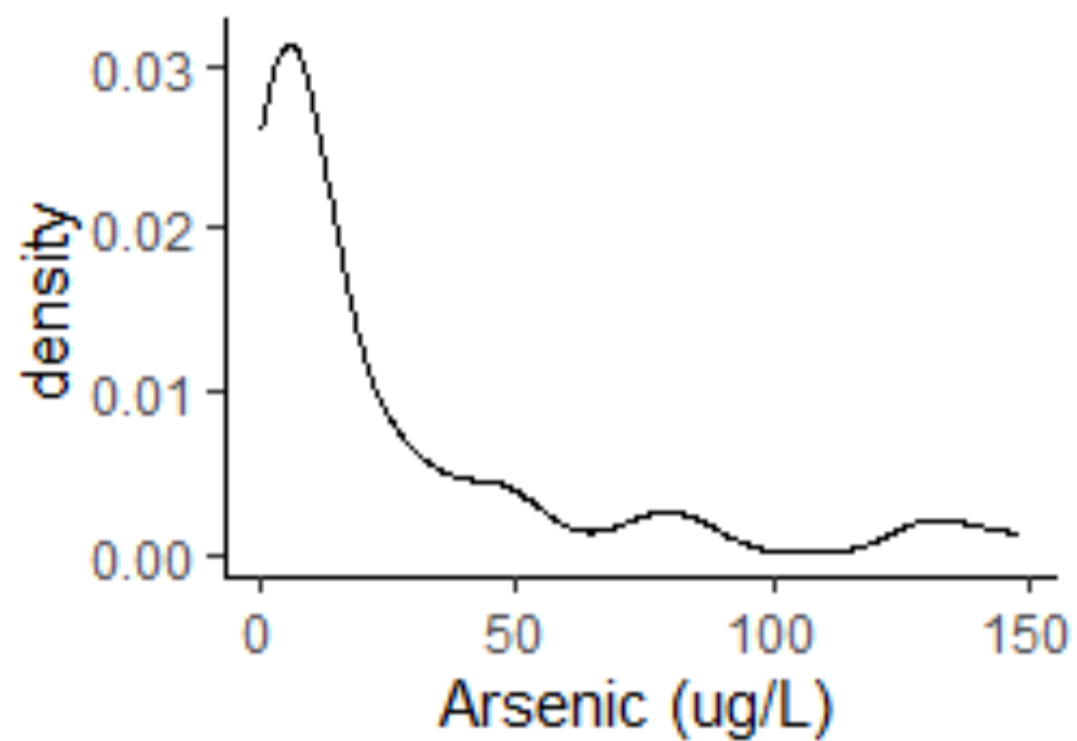
ICP-MS/MS Analysis

Data Integration



# Preliminary Heavy Metal Exposure Results

Performed heavy metal analysis for the first batch of samples (50/767). The distribution for Arsenic, Lead, Antimony, Cobalt, Copper in urine samples are shown below.

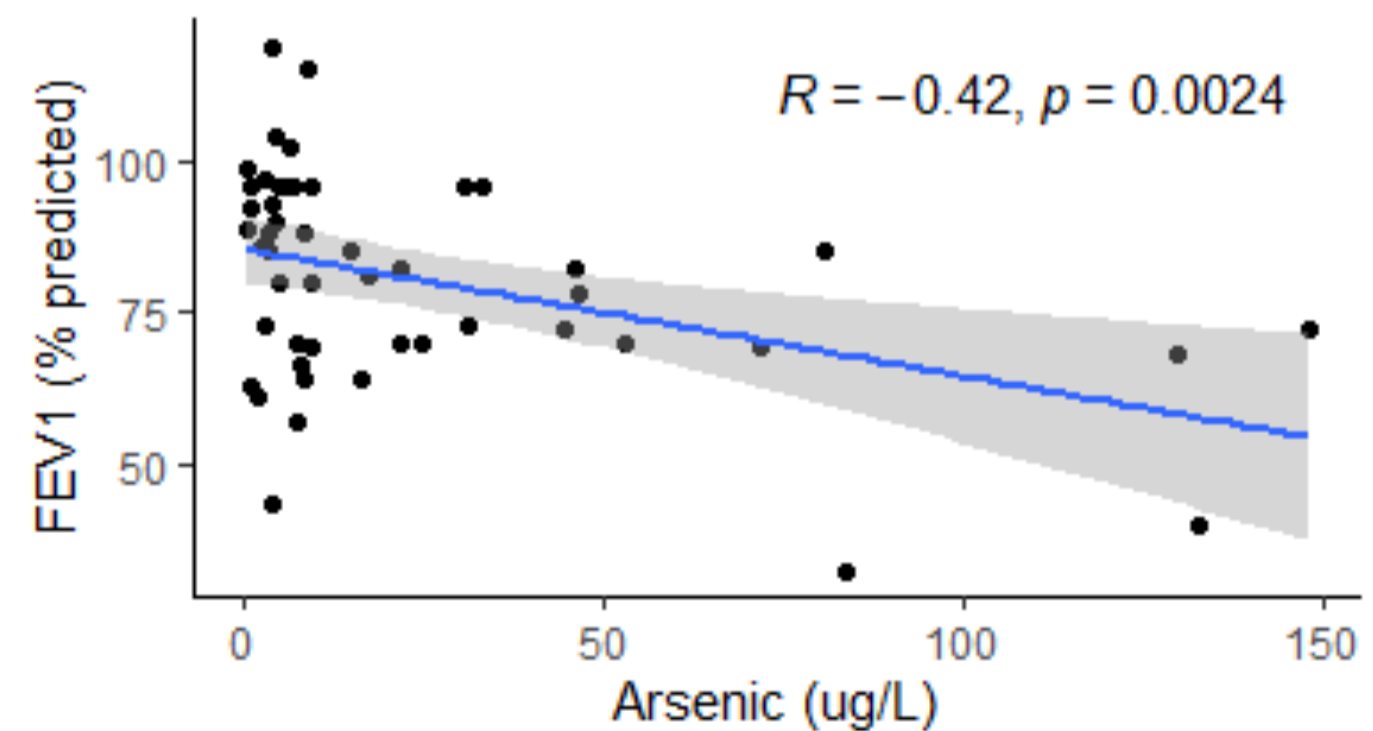
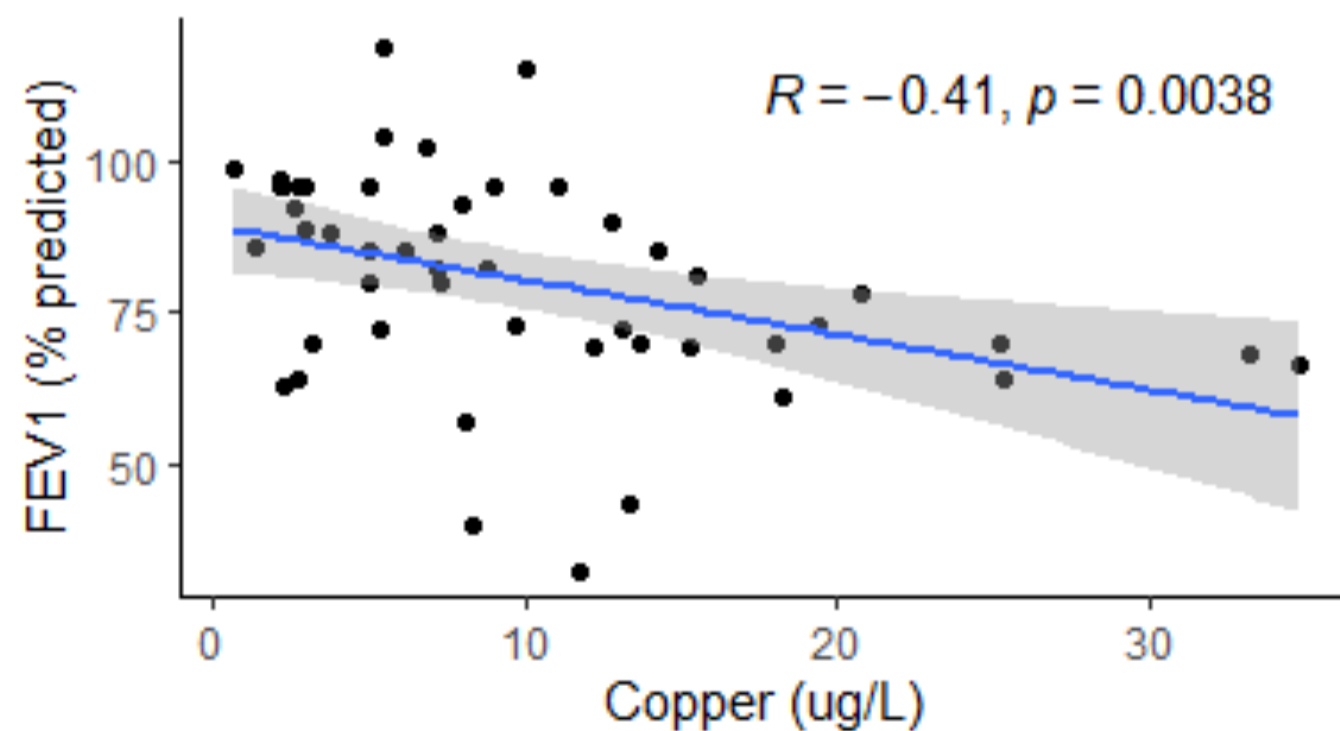
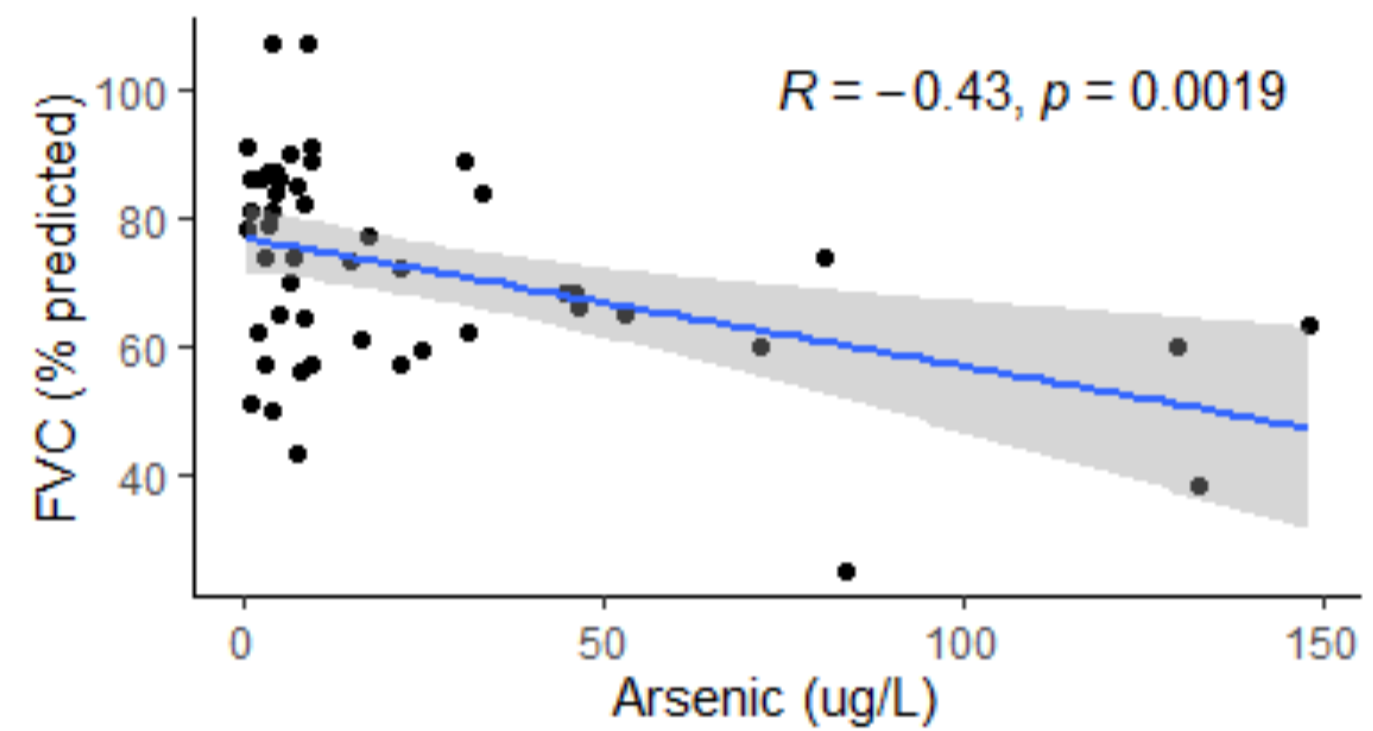
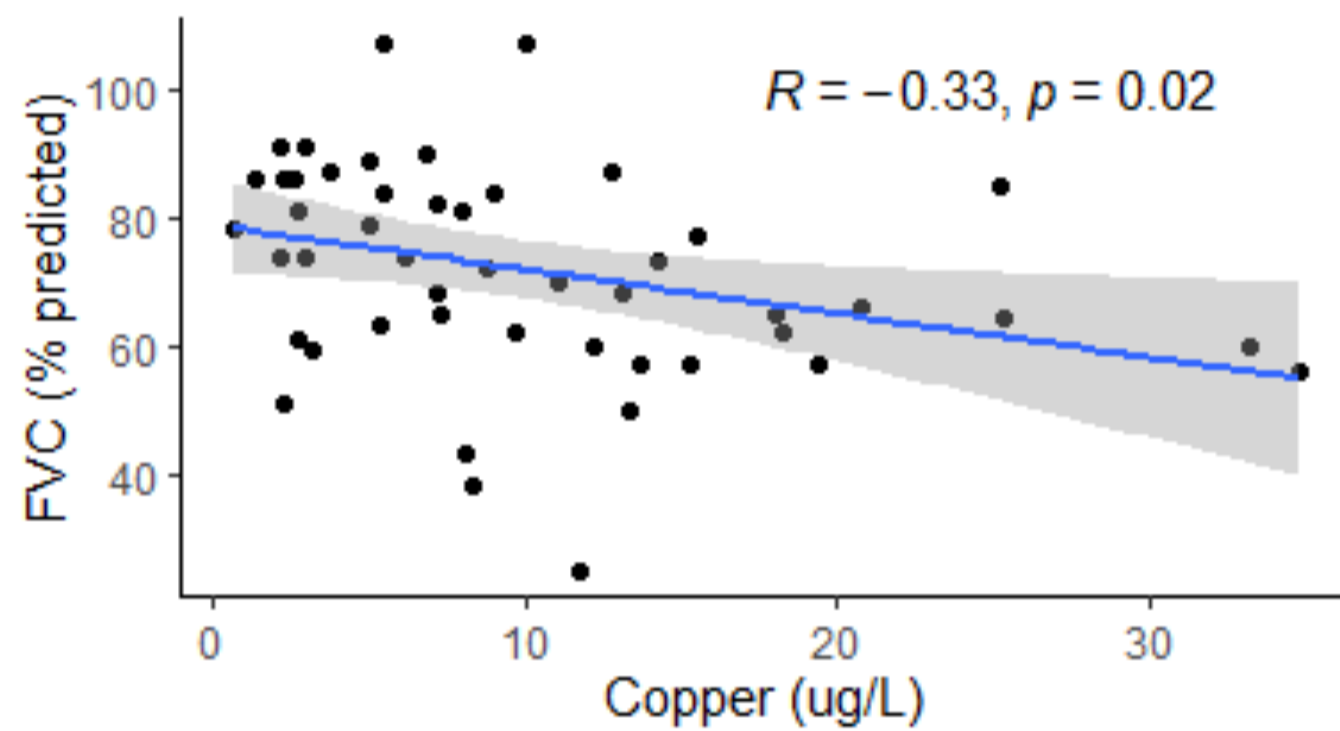




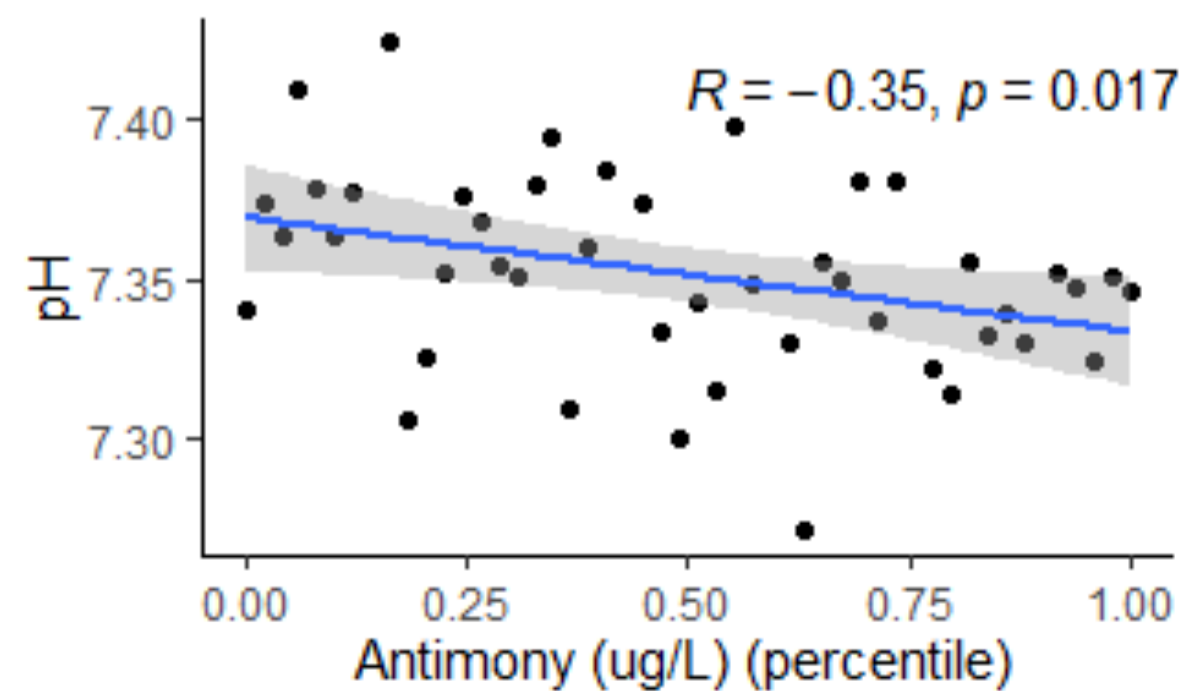
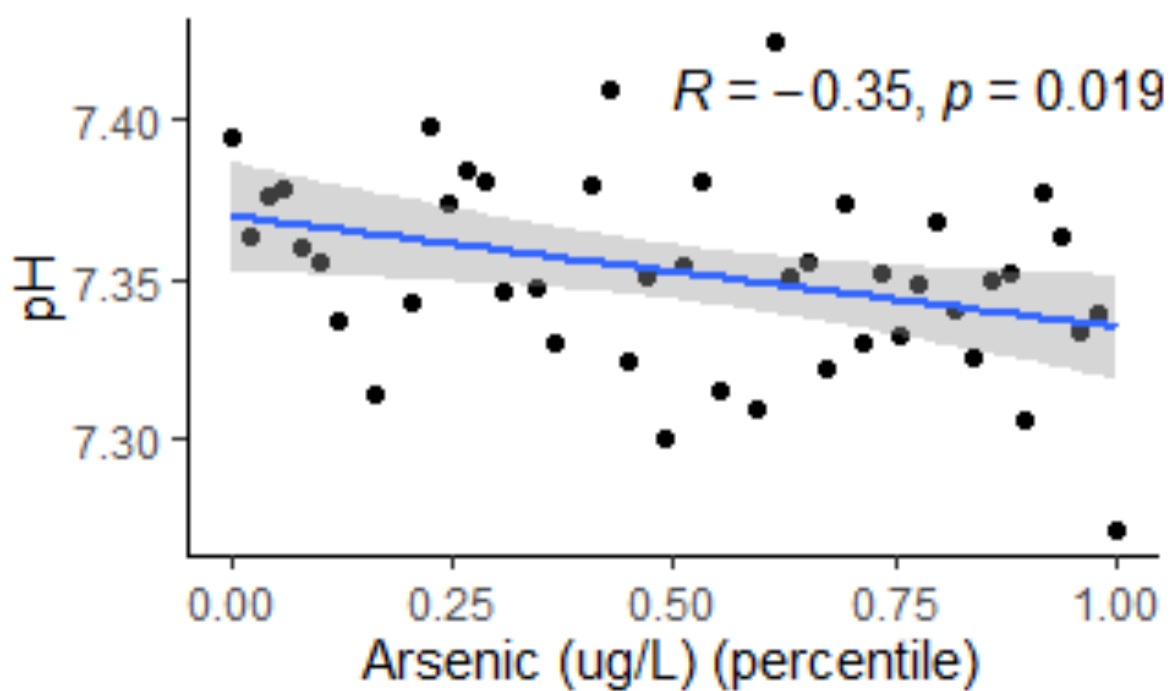
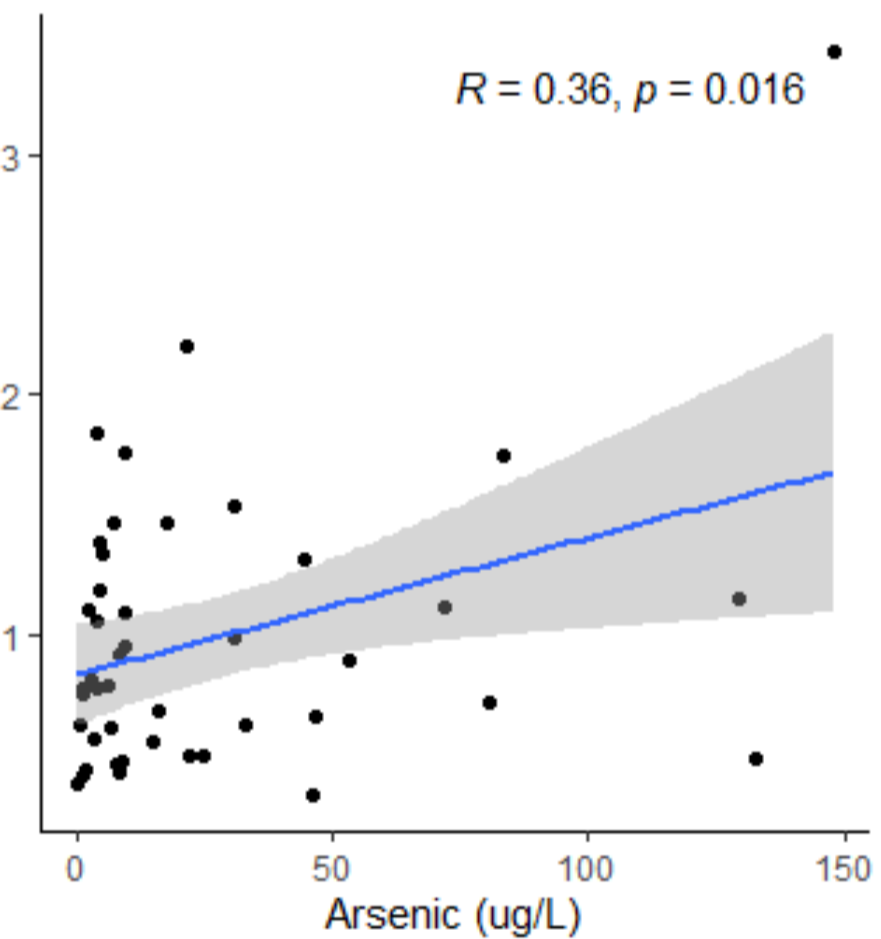
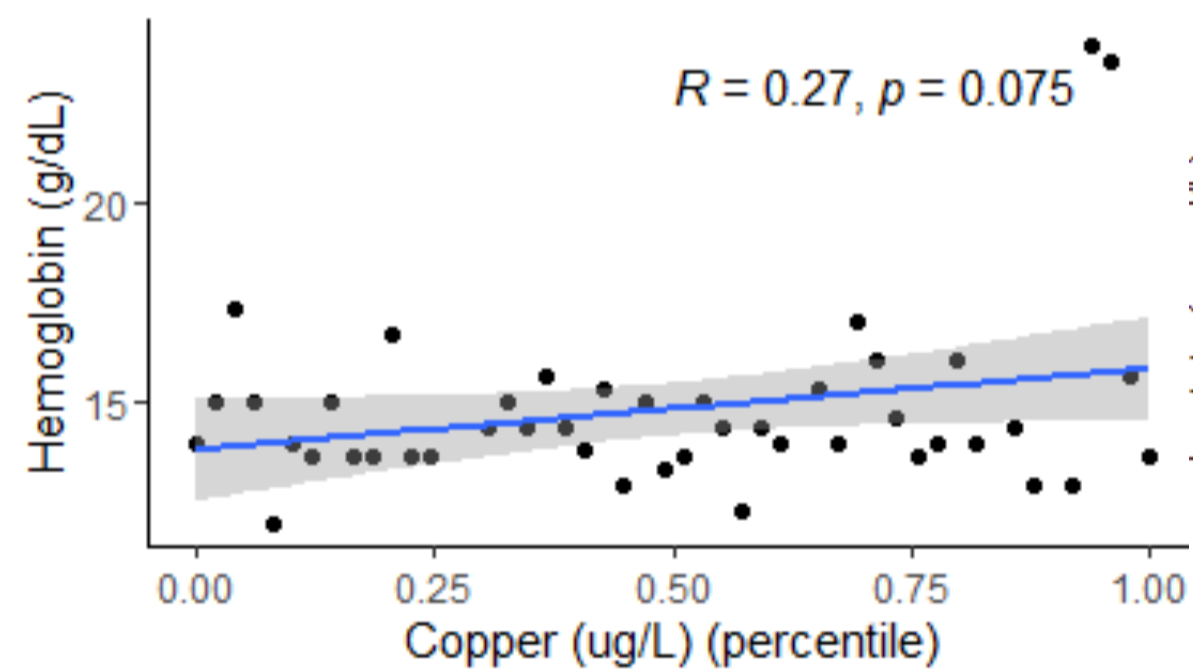
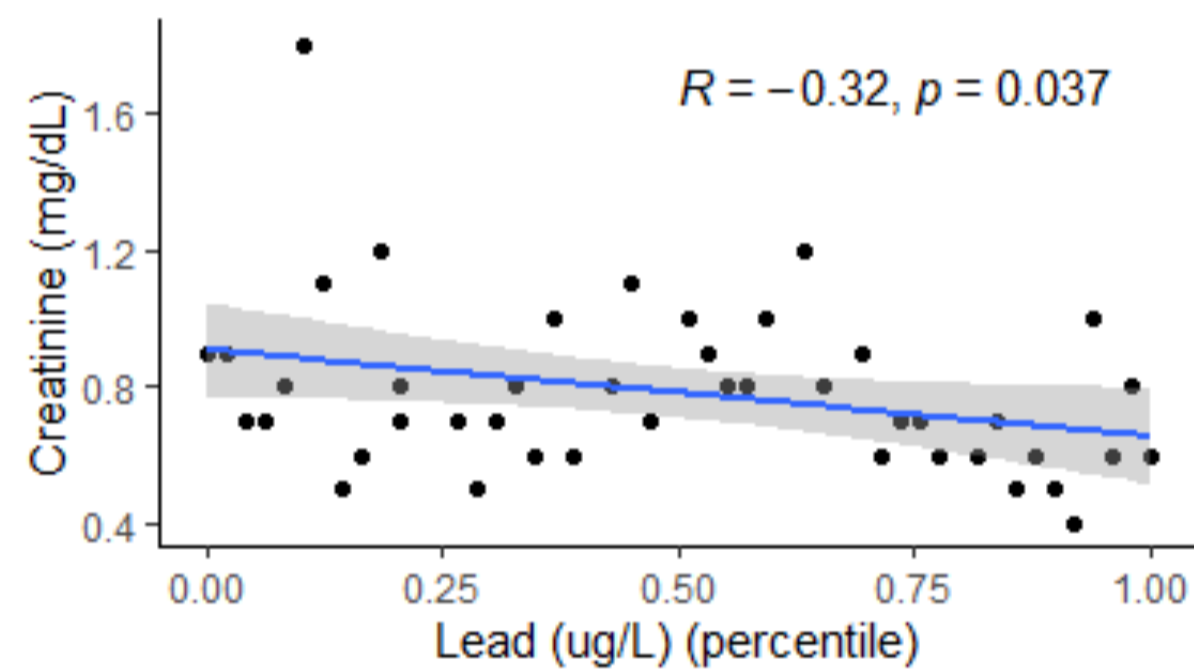
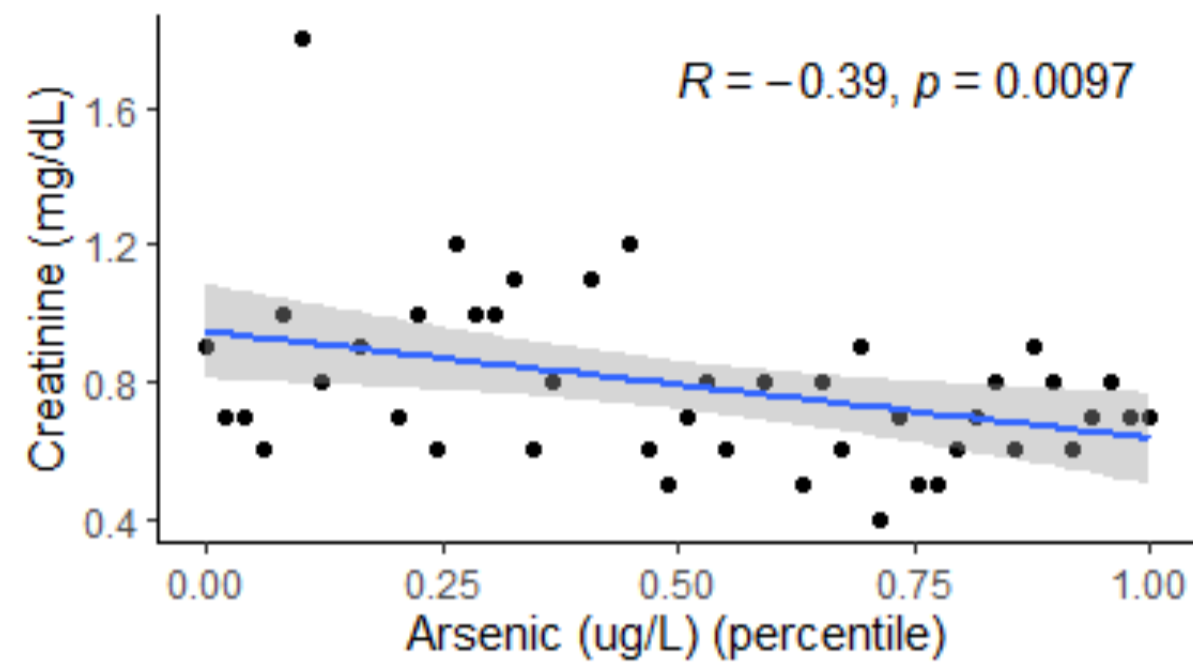
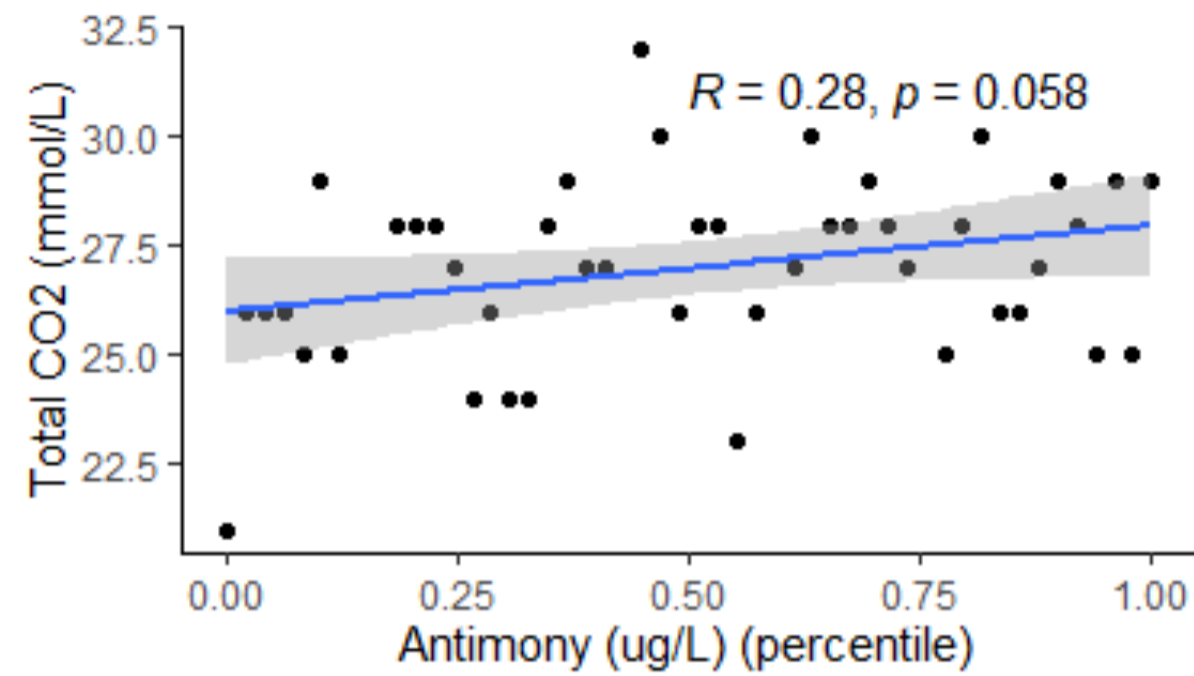
# High levels of copper & arsenic associate with poor lung function

**FVC (% predicted):** Measures total air exhaled & indicates restrictive lung disease if low.

**FEV1 (% predicted):** Shows air exhaled in 1 second & suggests obstructive lung disease if low.

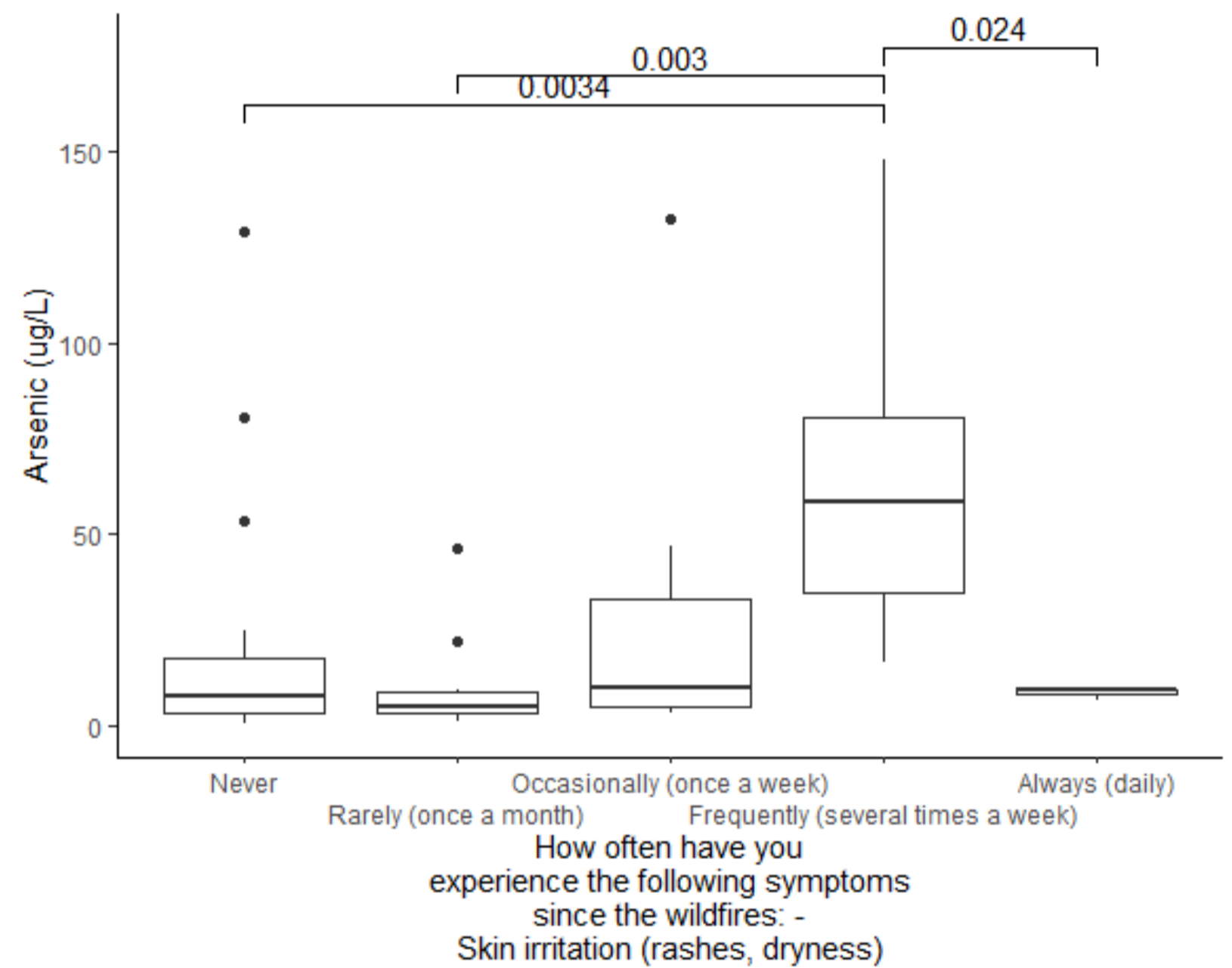
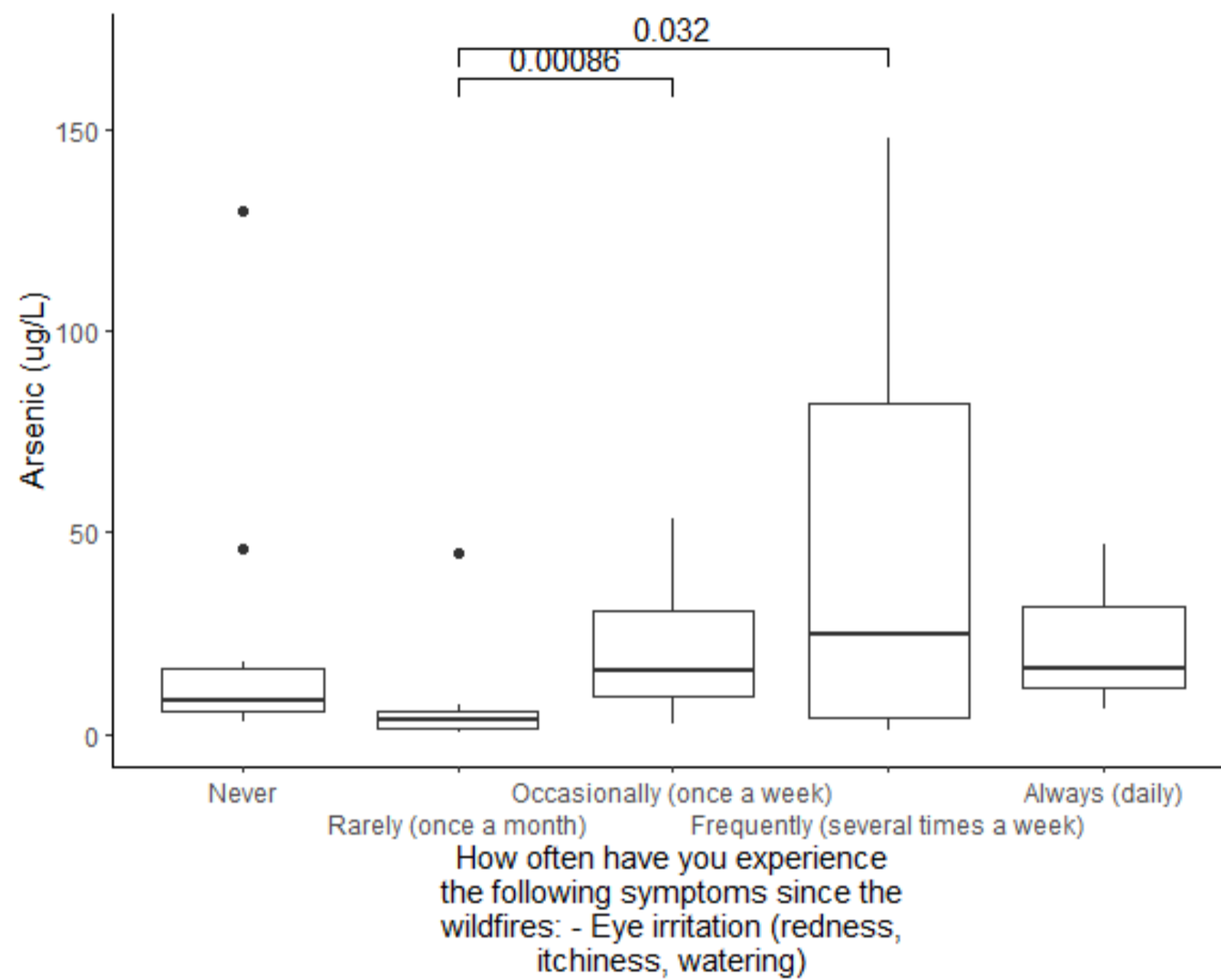


# Heavy metals & blood biomarkers



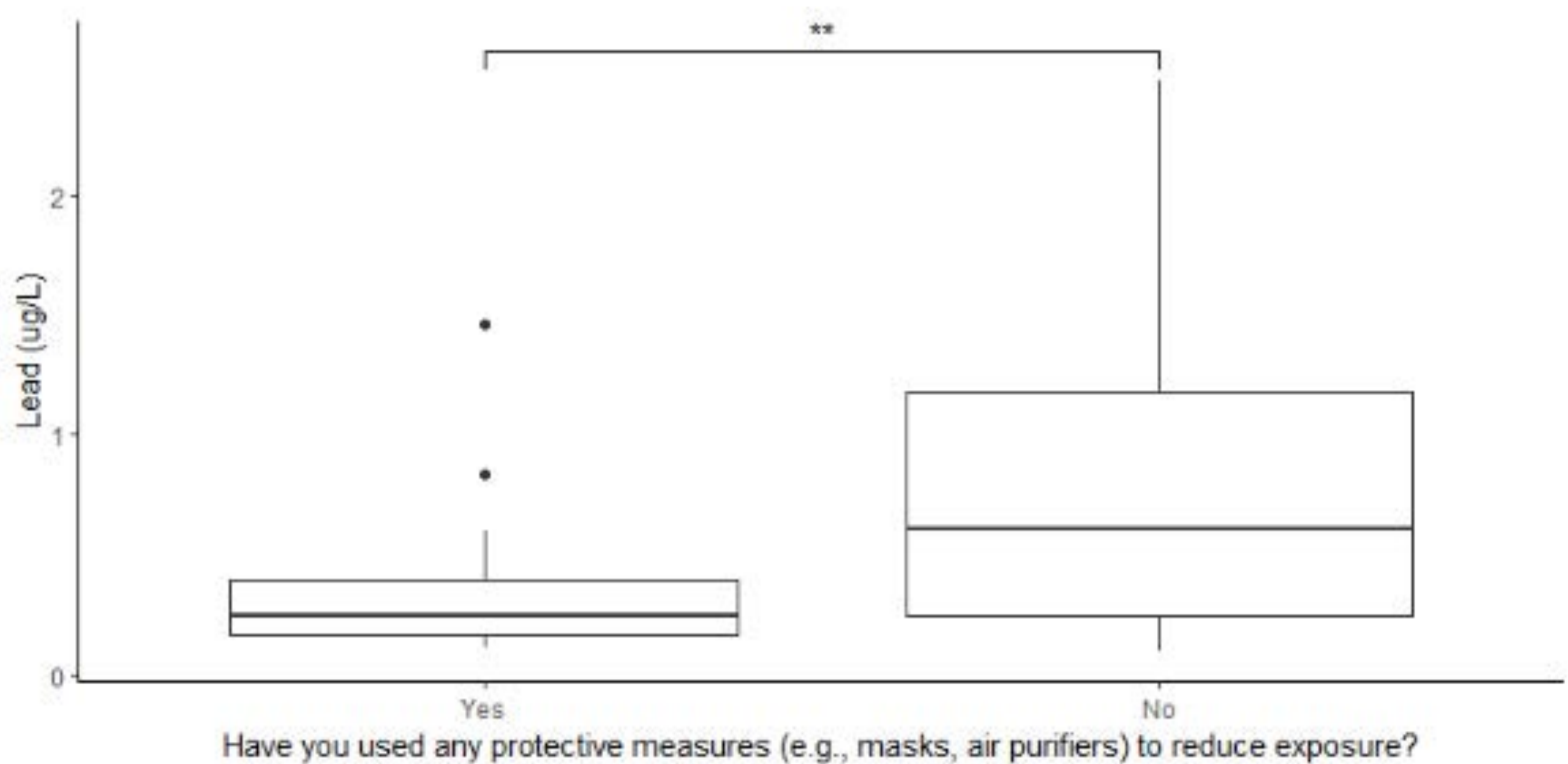
# Self-reported symptoms associate with arsenic levels

Higher frequency of either **eye or skin irritation** shows a significantly higher level of arsenic from urine samples.



# Protective measures associate with lower levels of urine lead

Participants who reported using protective measures to reduce exposure also had significantly lower levels of lead in their urine samples.



# Summary & Recommendations

- **Medical Care and Accessibility:** Focus on expanding access to healthcare and insurance coverage for individuals affected by the wildfires, particularly in light of urgent needs for pulmonary, cardiovascular, and mental health support- integration.
- **Housing Stability:** Ensure stable, long-term housing solutions for displaced individuals through policies supporting housing supply, financial aid, and access to affordable options.
- **Environmental Safety:** Reduce post-wildfire environmental hazards by cleaning up affected areas, monitoring air and water quality during clean-up, and educating residents about protective measures.
- **Community Support:** Strengthen community networks and engage local organizations to provide culturally sensitive support and enhance resilience.
- Develop strategies for targeted support for the most vulnerable individuals, including low-income households, food insecure households, immigrants, people with pre-existing physical and mental health conditions and people with disabilities, in terms of healthcare access and socioeconomic needs.



# Mahalo to Our Partners & Funders



Hawai'i Community Foundation

**MAUI  
STRONG  
FUND**



**KAISER PERMANENTE®**



**ROOTS REBORN**



**UNIVERSITY OF HAWAII  
CANCER CENTER**



**COLLEGE OF SOCIAL SCIENCES**

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