University of Hawai‘i

Maui Wildfire Exposure Study

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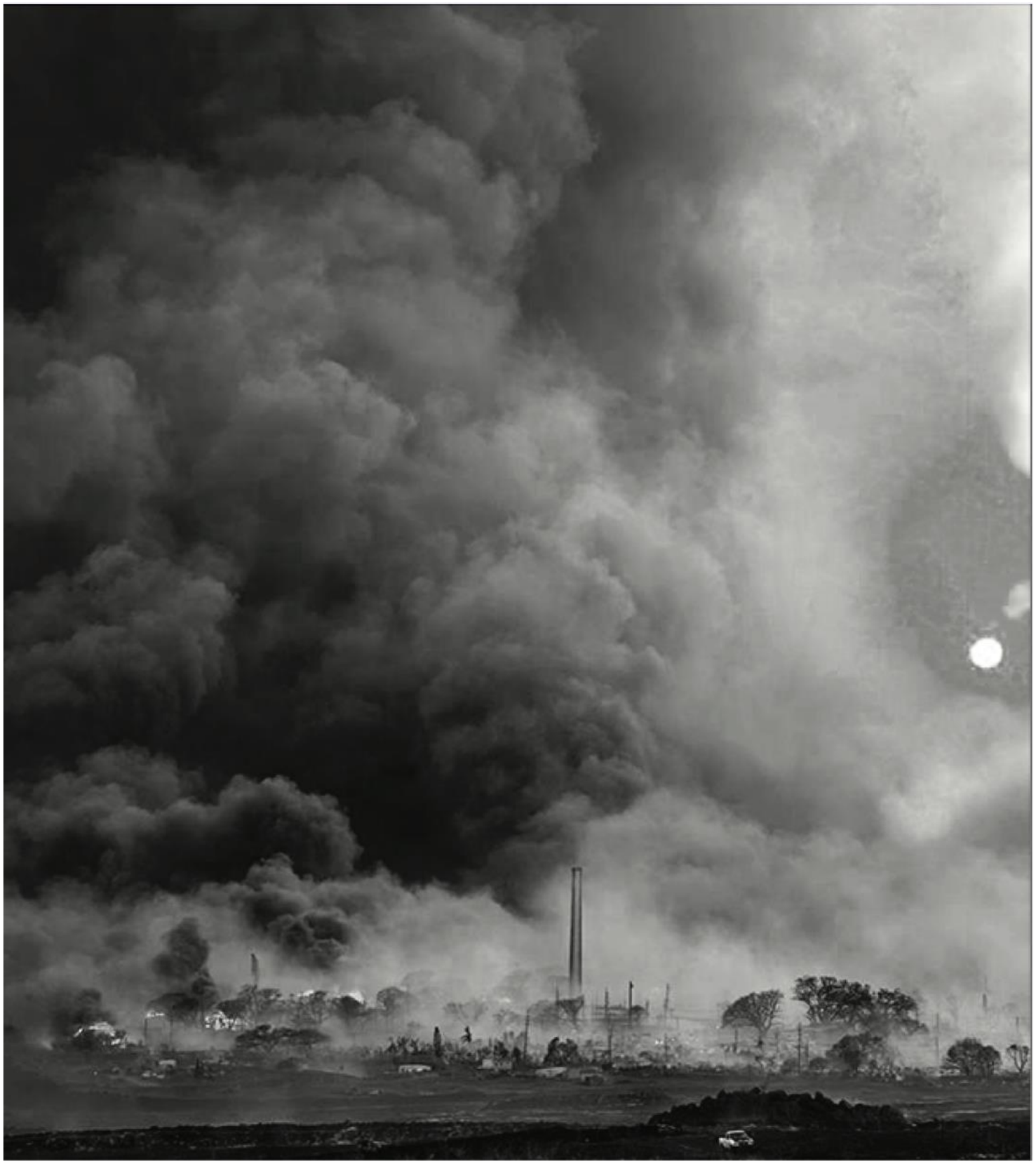
MauiWES.org

NIH R61MD019793

August 2023 Maui Wildfires



Lahaina Fire Comprehensive Timeline Report

UL Research Institutes

Steve Kerber
Derek Alkonis

This publication is available free of charge from:
https://doi.org/10.54206/102376/VQKQ5427

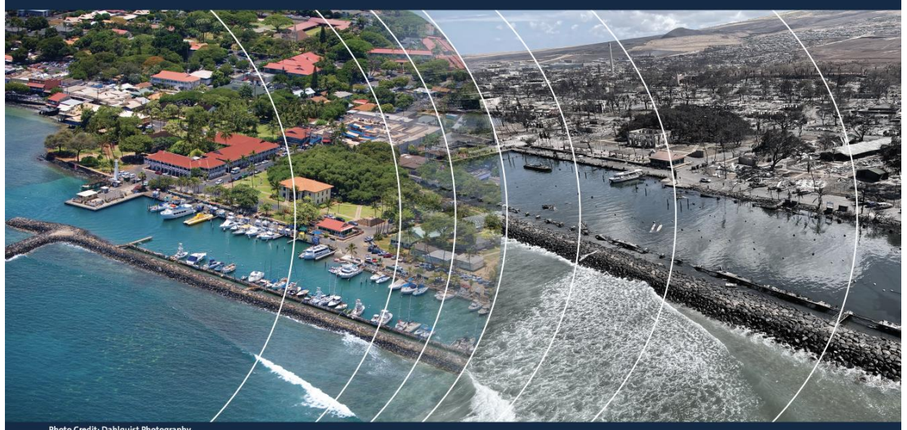
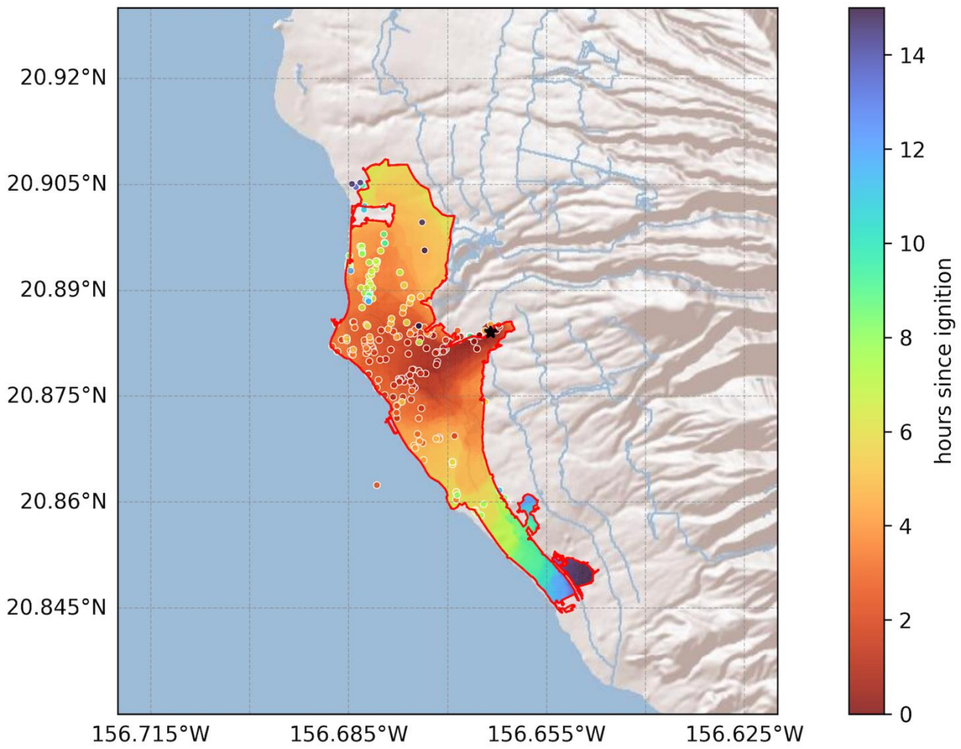
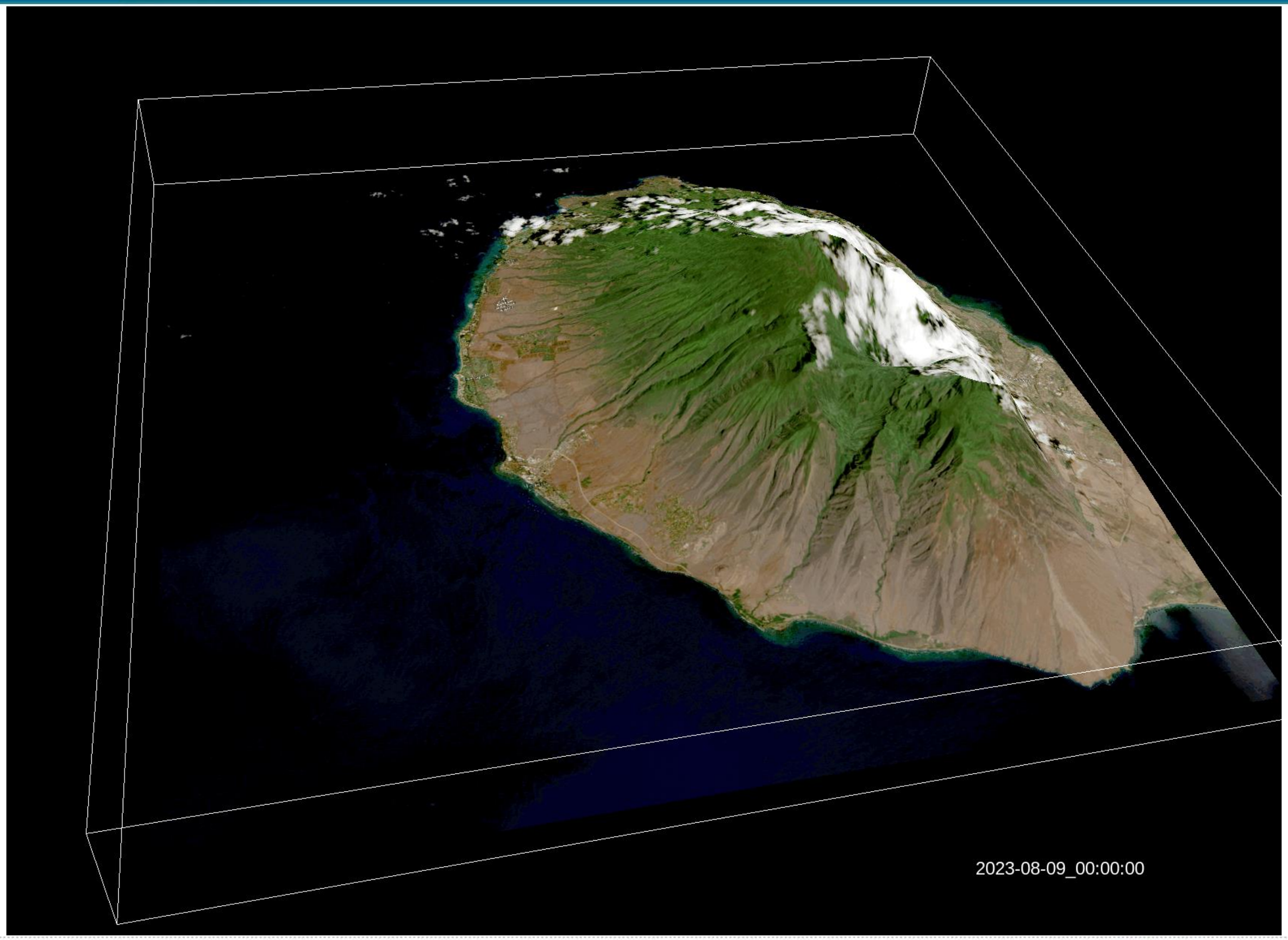


Photo Credit: Dahlquist Photography

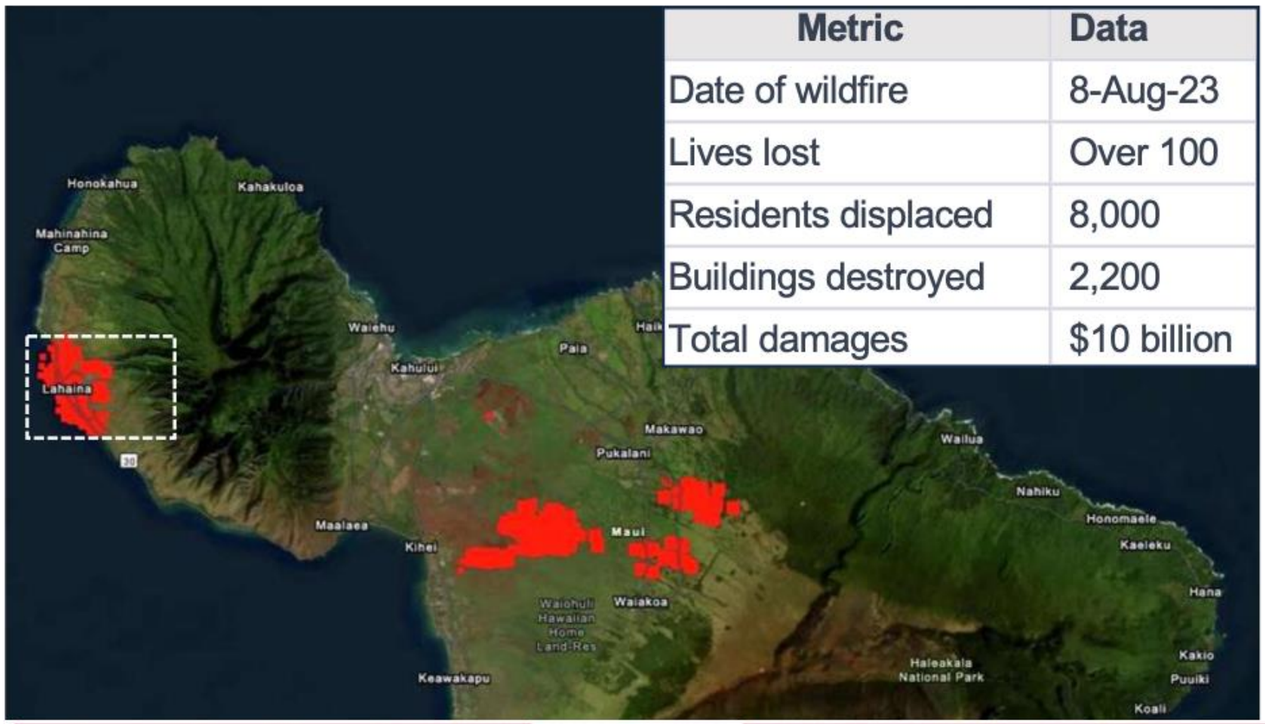
Fire Safety Research Institute
April 17, 2024
Columbia, MD



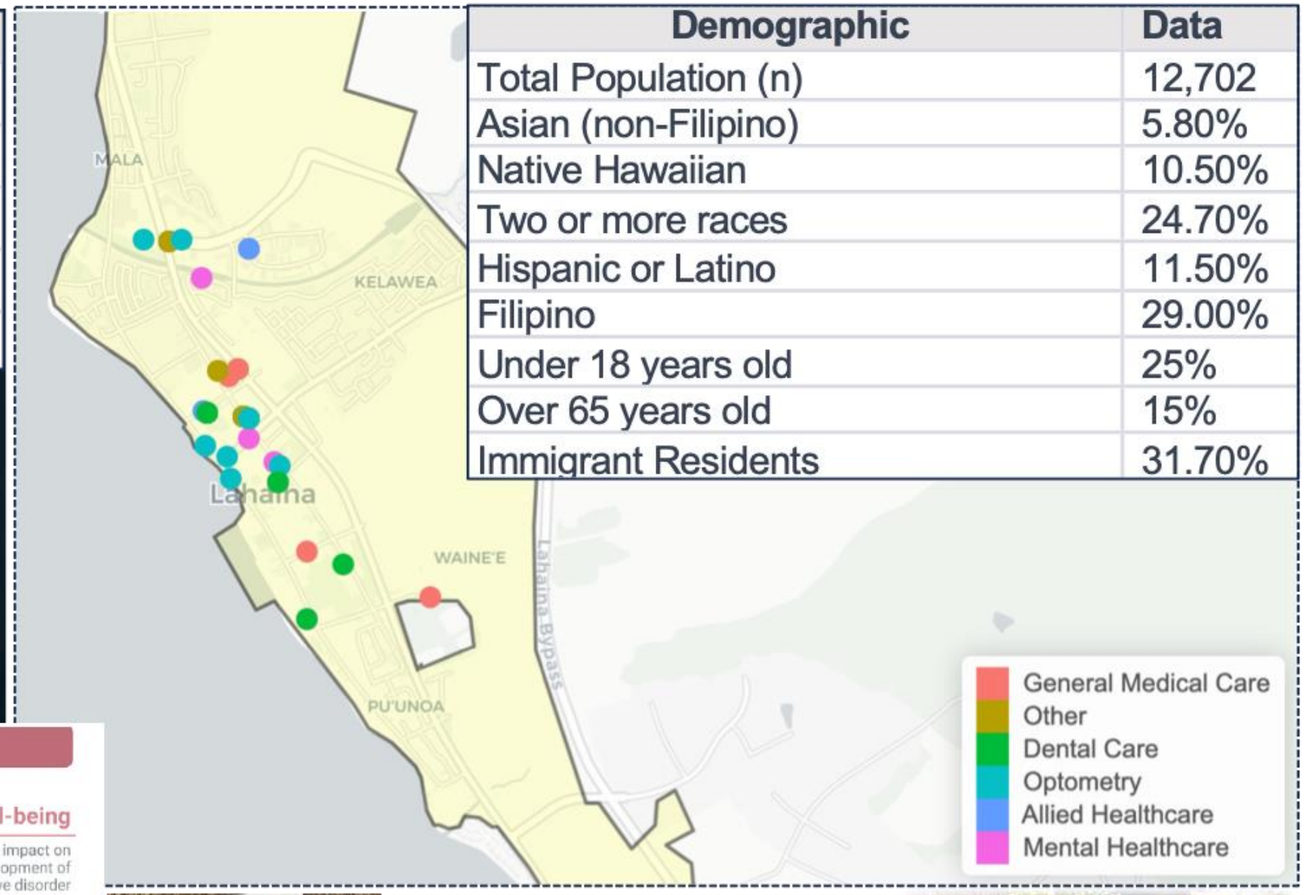
August 9, 2023 Lahaina Fires Model (SOEST)



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



Demographic	Data
Total Population (n)	12,702
Asian (non-Filipino)	5.80%
Native Hawaiian	10.50%
Two or more races	24.70%
Hispanic or Latino	11.50%
Filipino	29.00%
Under 18 years old	25%
Over 65 years old	15%
Immigrant Residents	31.70%

Short to Mid-Term Effects of Exposure

Headaches, dizziness, reduced O_2 transport

Smoke pollutants (including CO and CO_2) can reduce oxygen transport, causing symptoms of oxygen deprivation.

Eye irritation and vision complications

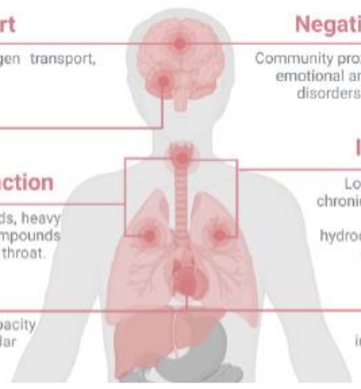
Fine particulate matter can directly irritate the eyes.

Respiratory irritation and reduced lung function

Fine particulate matter (PM2.5; can include inorganic compounds, heavy metals, etc), gases (CO, CO_2, SO_2, NO_2, 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

The worst natural disaster in the state of Hawai‘i and the deadliest fire in the US in over a century, threatening to further widen health disparities in our community.

Health Disparity Research & Academic-Community Partnerships

PAAC
Pacific Alliance Against COVID19
www.PAAC.info

Pacific Alliance Against COVID-19 recruited over 30,000 participants and performed over 50,000 COVID tests during the pandemic in partnership with several FQHCs and Schools
www.PAAC.info

UHERO
THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAI'I

PUBLIC HEALTH REPORT

SHAPING HEALTH IN HAWAII: THE INFLUENCES OF POVERTY, HOUSING AND FOOD INSECURITY

JULY 12, 2023

Over 2000 state of Hawaii residents are enrolled in biannual cohort to understand social determinants of health and be ready for the next disaster

www.uhero.hawaii.edu

Hawai'i Social Epigenomics Early Diabetes Cohort

2100 residents, primarily Native Hawaiian and Pacific Islanders are enrolled to understand the early origins of diabetes

www.hiseed.org

Multidisciplinary research initiatives to address health disparities in Hawai‘i: Blended with health education and health services

Maui Wildfire Exposure Study (MauiWES) - Team

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Papa Ola Lōkahi

healthymothers healthybabies COALITION OF HAWAII

HUI NO KE OLA PONO

MauiWES

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HAWAII STATE DEPARTMENT OF HEALTH

VARIOUS DOCTORS AND PARTNERS FROM MAUI

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NIH National Institute on Minority Health and Health Disparities
Advancing the Science of Minority Health and Health Disparities

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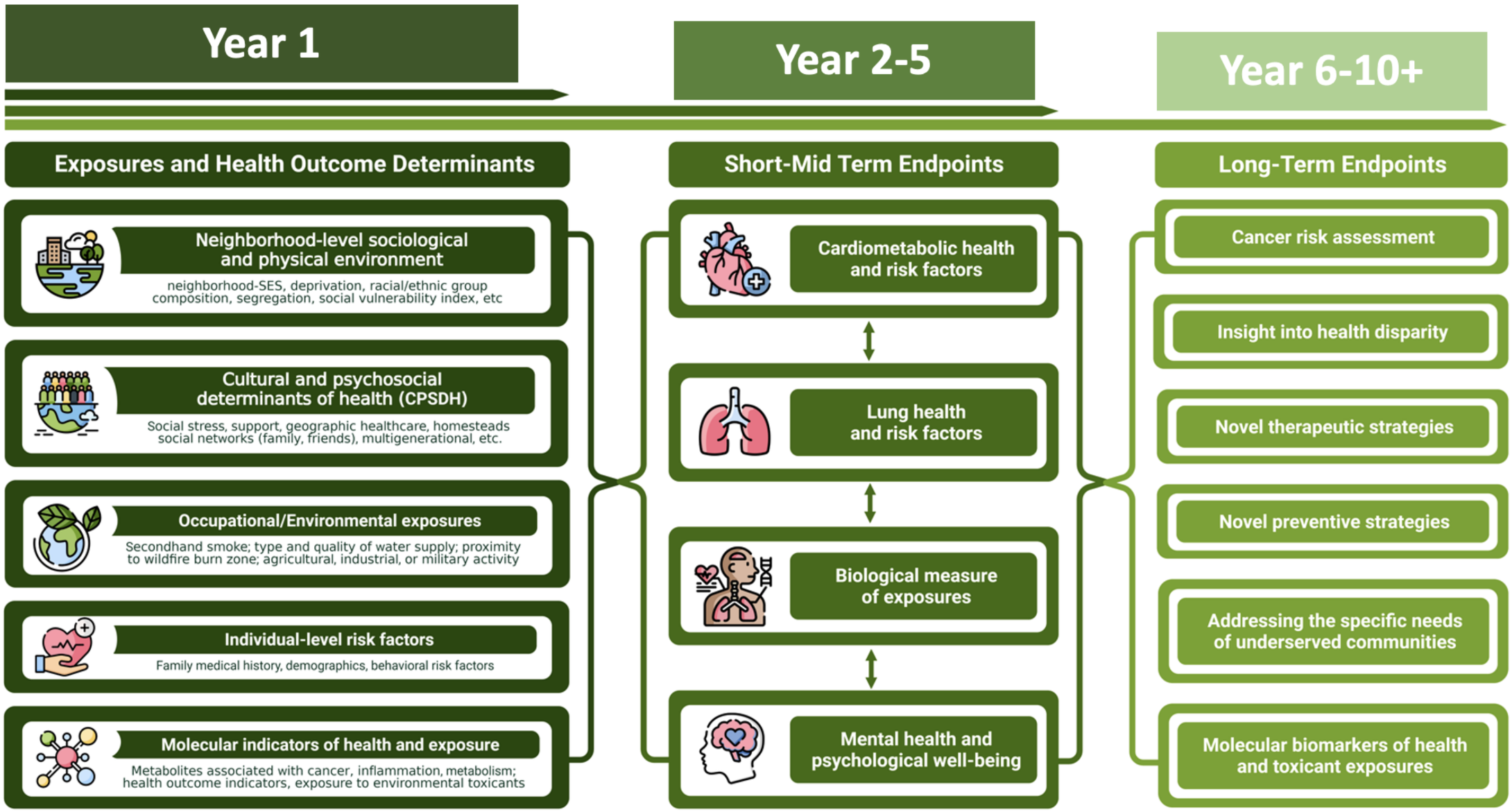
MauiWES - Goals and Timeline



Objective: Establish a cohort of ~2,000 individuals 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…*

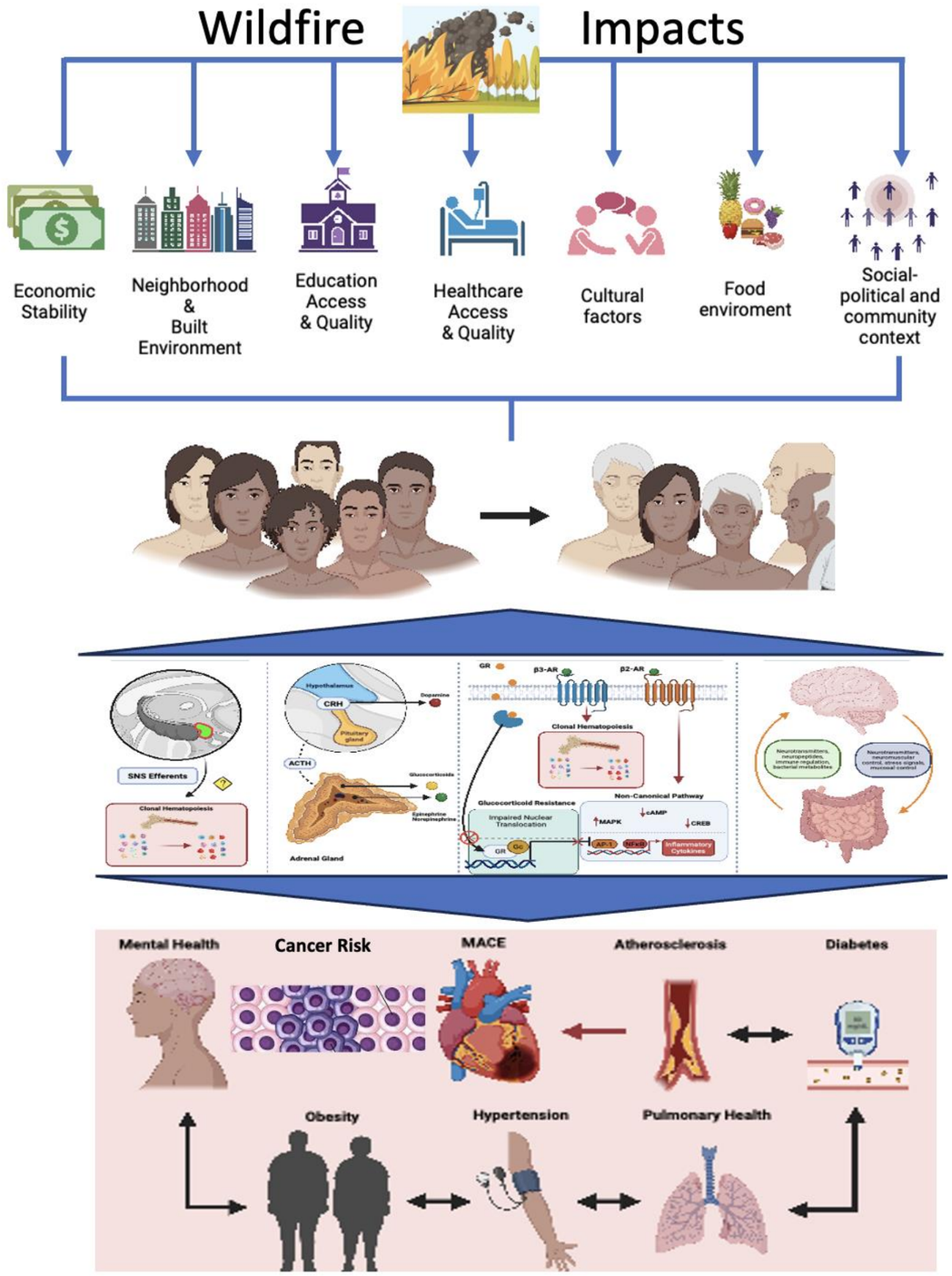
Biospecimens

- Stress Response
- Inflammation
- Environmental Toxicants

Health Exam

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

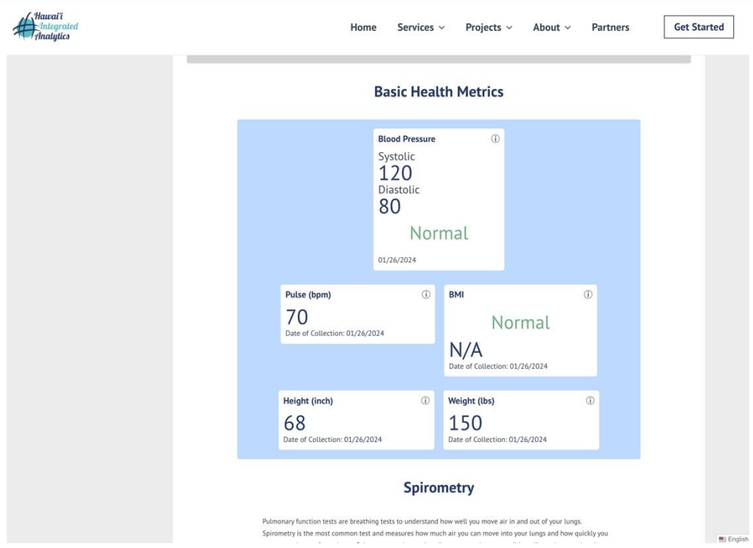
Participant Involvement



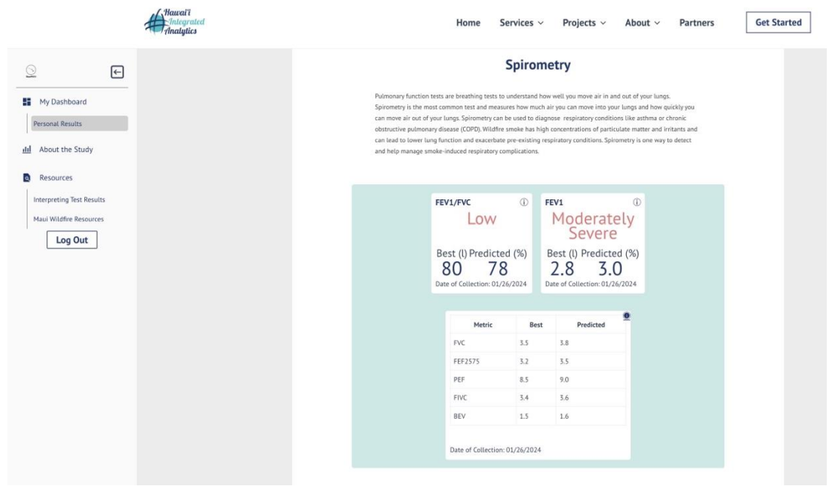
Enrolled: 1700+ (~ 35 recruitment days); first health screen since the fires for many.

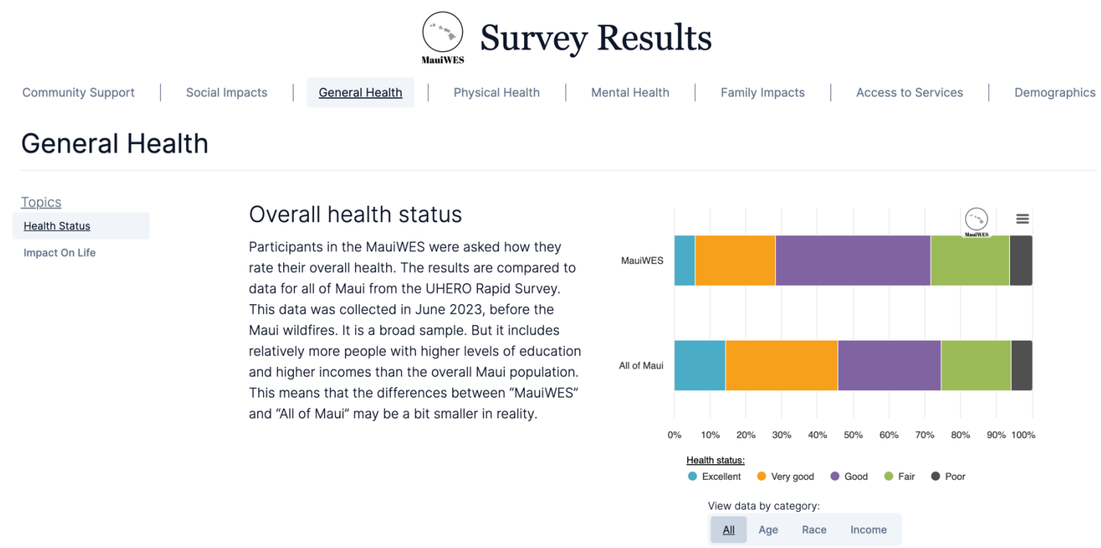
Dissemination - Participant Data Portal and Dashboard

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

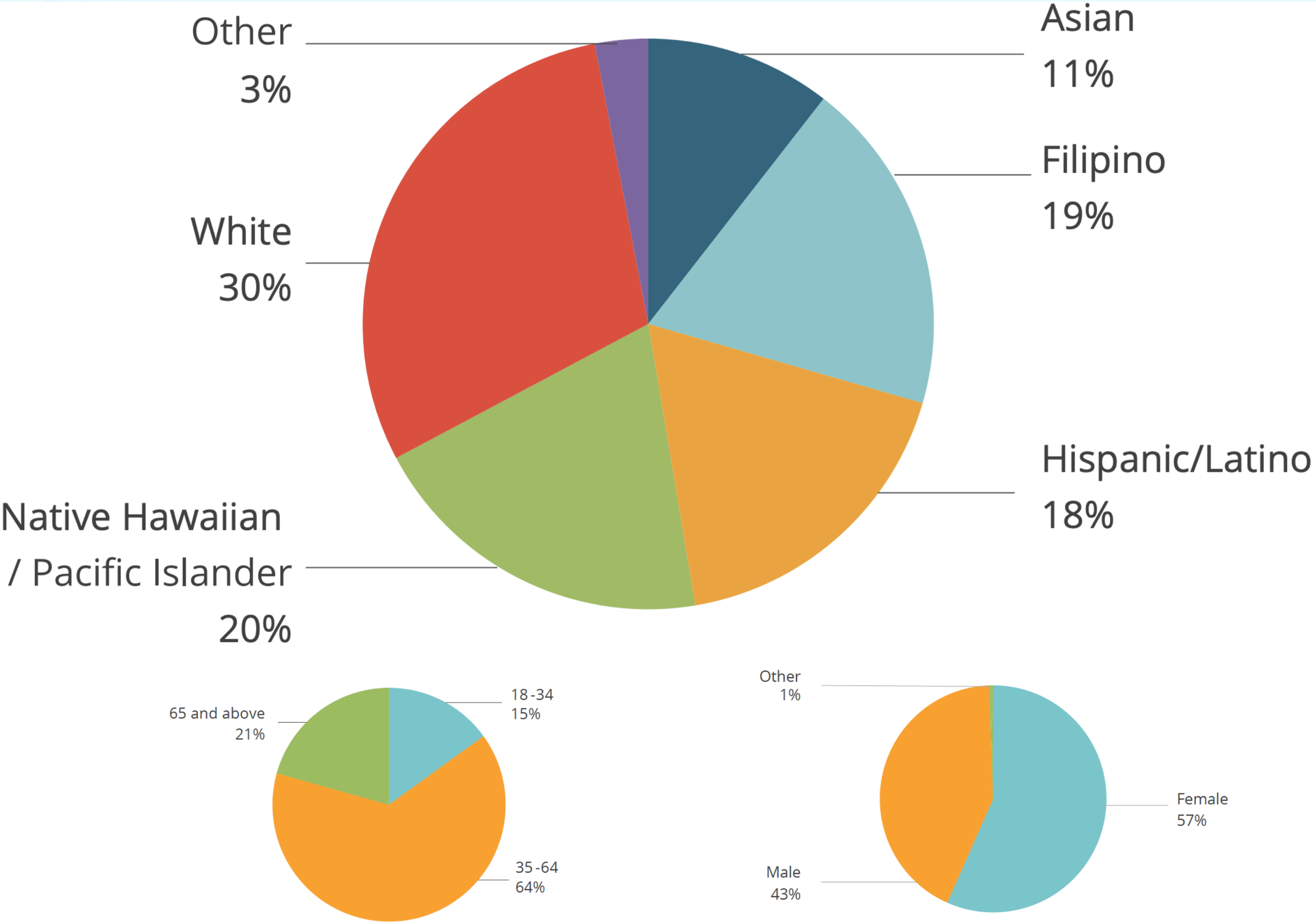


- We will connect participants to their results and at-risk individuals will be referred to relevant services/providers using a *de novo* **Wildfire Exposures Data Dashboard**





Diverse Cohort Representative of Impacted Population

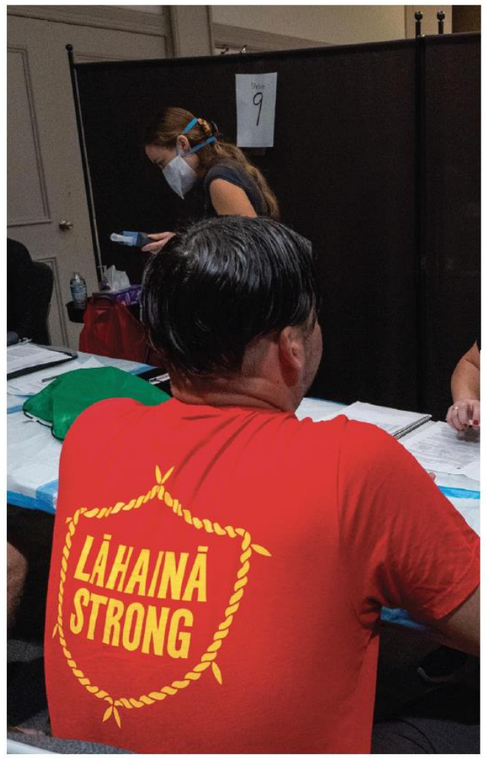


This is the most comprehensive and ethnically diverse study to evaluate short- & long-term health following a natural disaster in Hawai‘i.

MauiWES Main Findings So Far

Main trends detailed in the report:

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



PUBLIC HEALTH REPORT

MAUI WILDFIRE EXPOSURE STUDY: COMMUNITY HEALTH, WELLBEING, AND RESILIENCE

MAY 15, 2024

UHERO
THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAI'I

JOHN A. BURNS SCHOOL OF MEDICINE · UNIVERSITY OF HAWAII MANOA ·

MauiWES

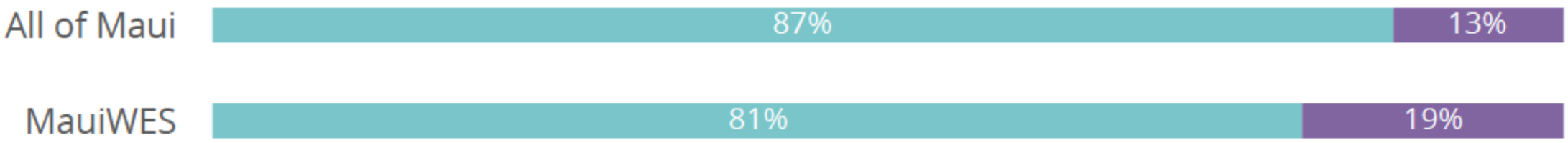
Post-fire Declines in Mental Health

Alarming rates of mental health issues among survivors:

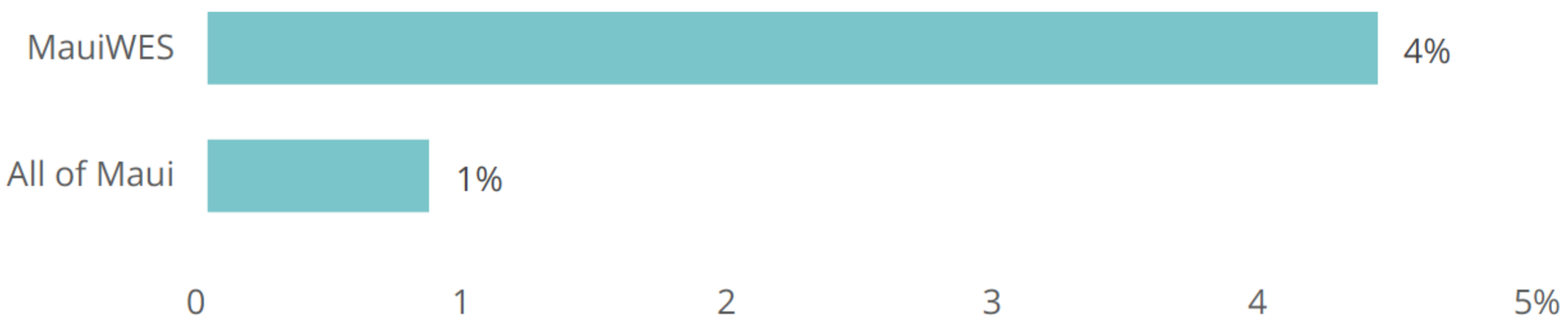
- 52% of participants showed depressive symptoms
- 19% reported low self-esteem
- 30% had moderate to severe anxiety
- 4.4% had considered suicide in the past month

Depression

Self-esteem

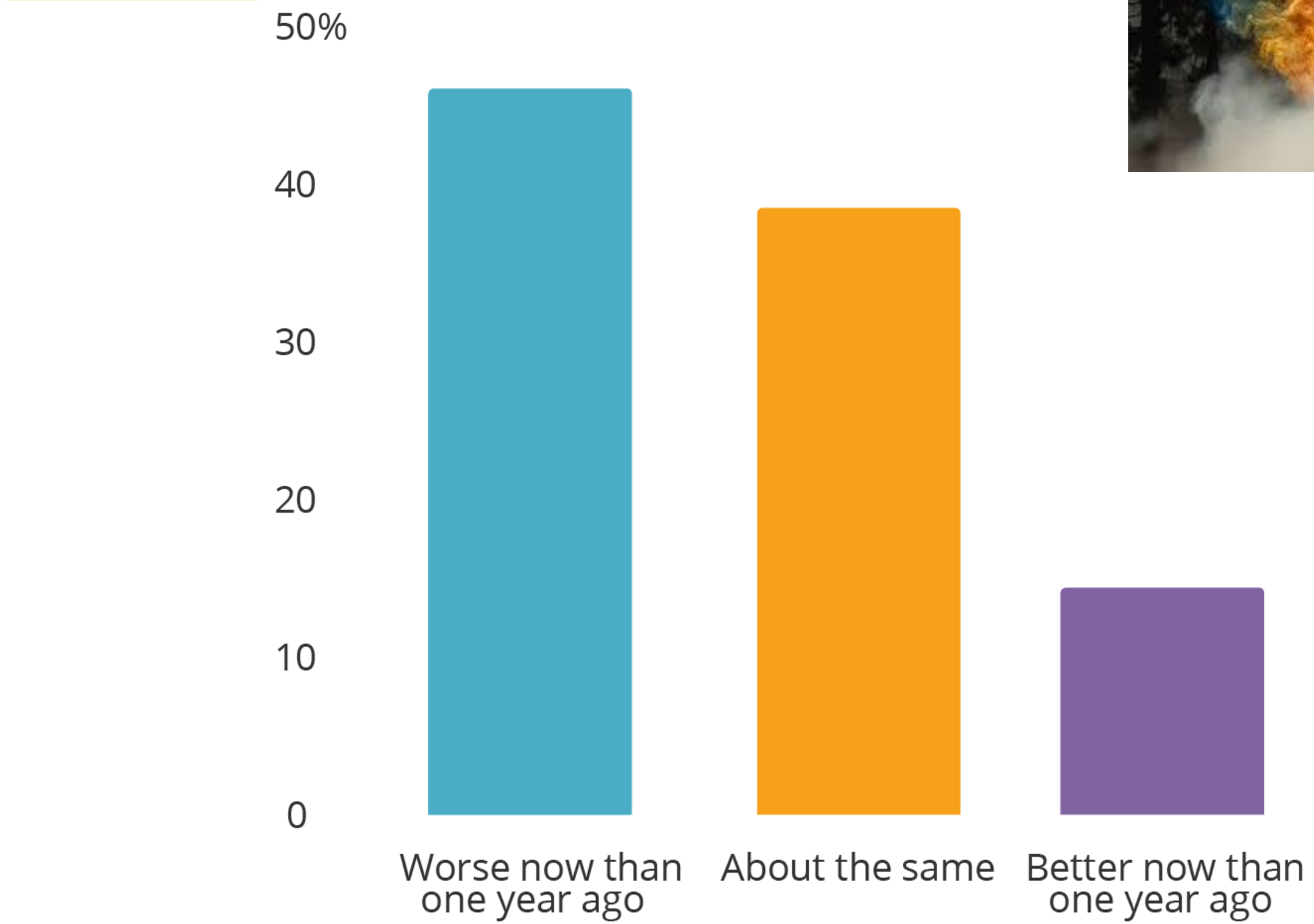


Suicidal ideation



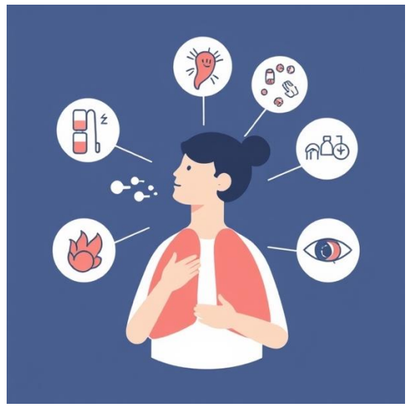
Post-fire Declines in Physical Health

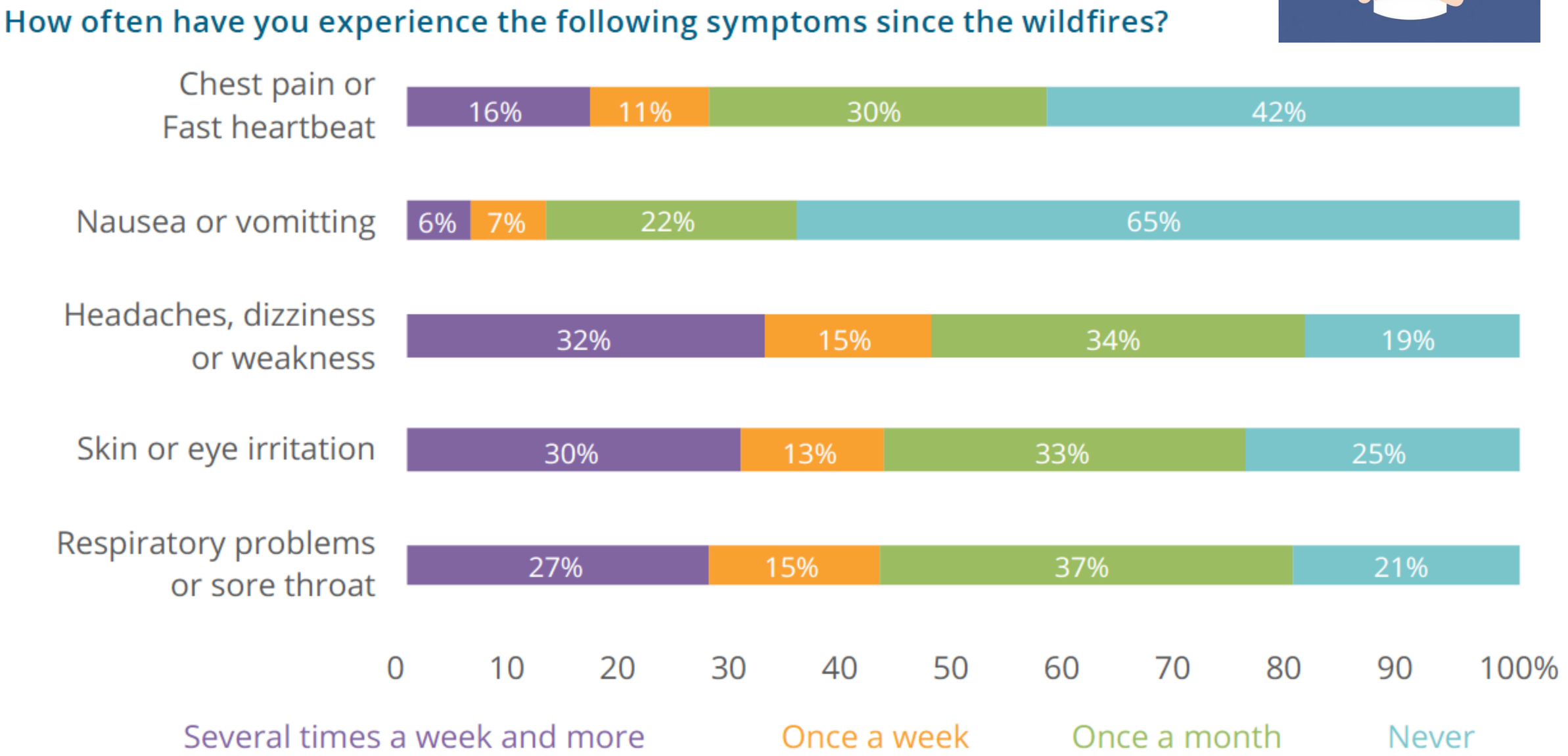
Nearly half of the participants reported worsened health since the wildfires, particularly among those with higher exposure to wildfire ash, debris, and smoke.



Symptoms & Health Screenings Validate Self-reports

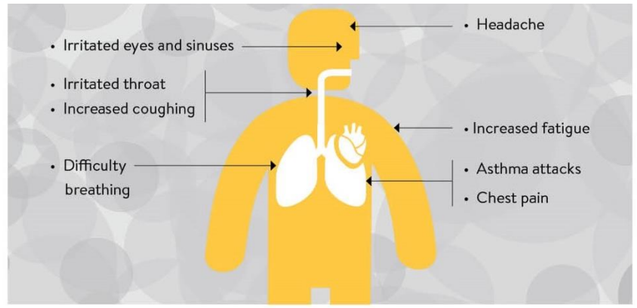
Respiratory issues (coughing, wheezing, difficulty breathing), skin/eye irritation, fatigue or weakness are the most common symptoms reported among participants.



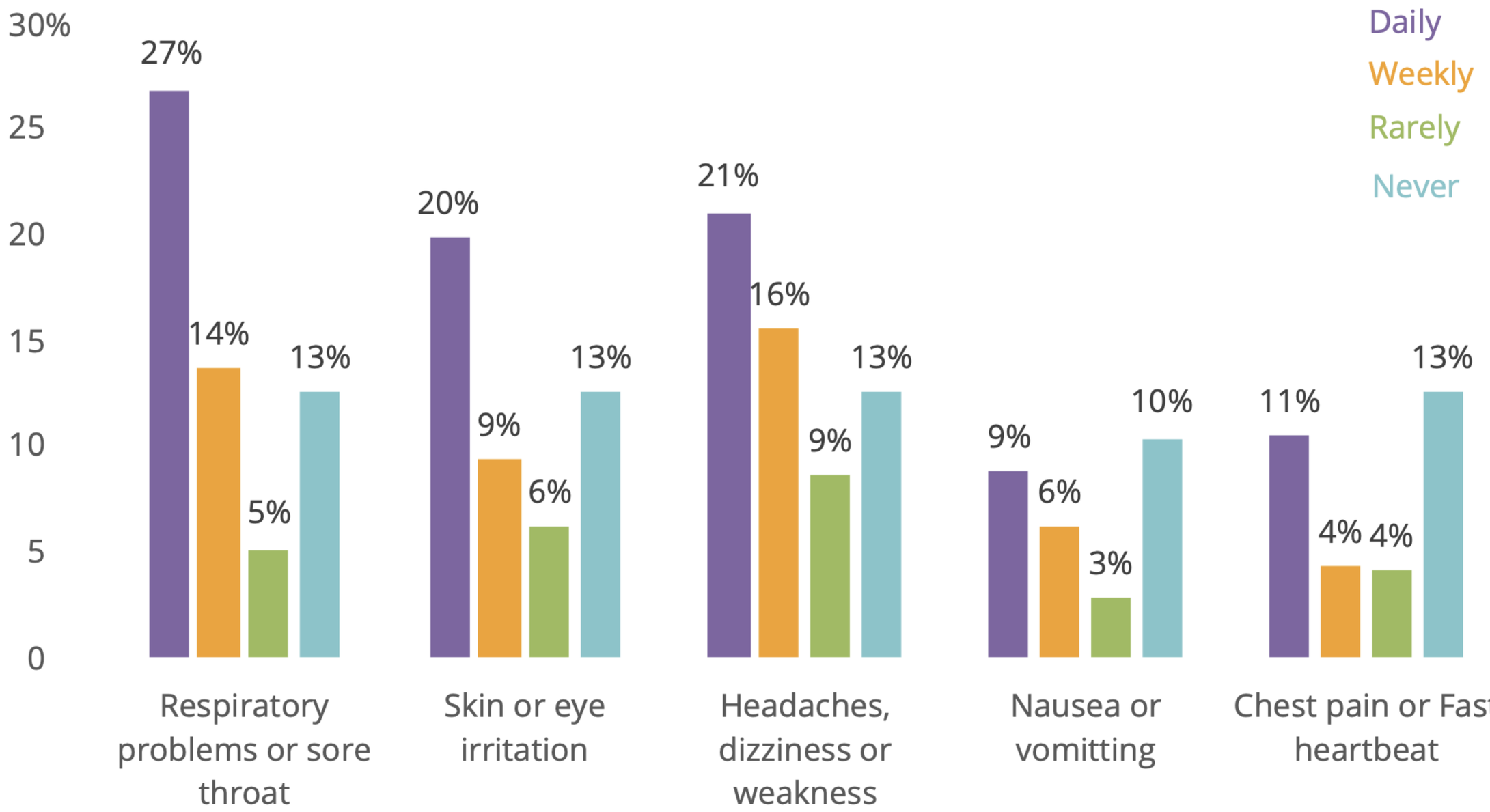


Self-reported Exposure Associates with Symptoms

Participants who reported frequent exposures to wildfire debris, smoke, and ash tended to experience more symptoms.

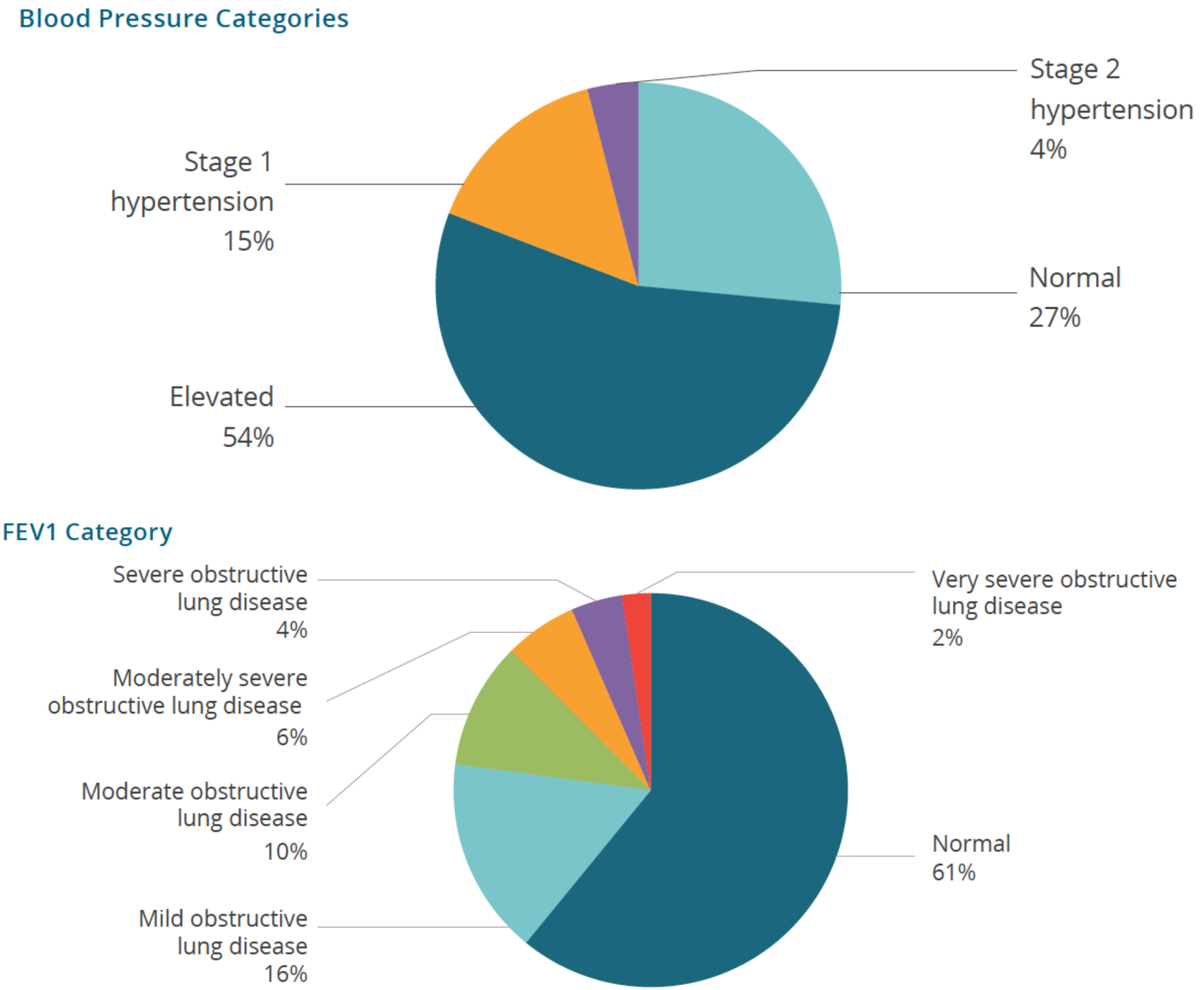


Percentage of responses of "Always/ Frequently" experiencing the symptoms since wildfires by the exposure to wildfire debris, smoke or ash



Prevalence of Cardiopulmonary Risk

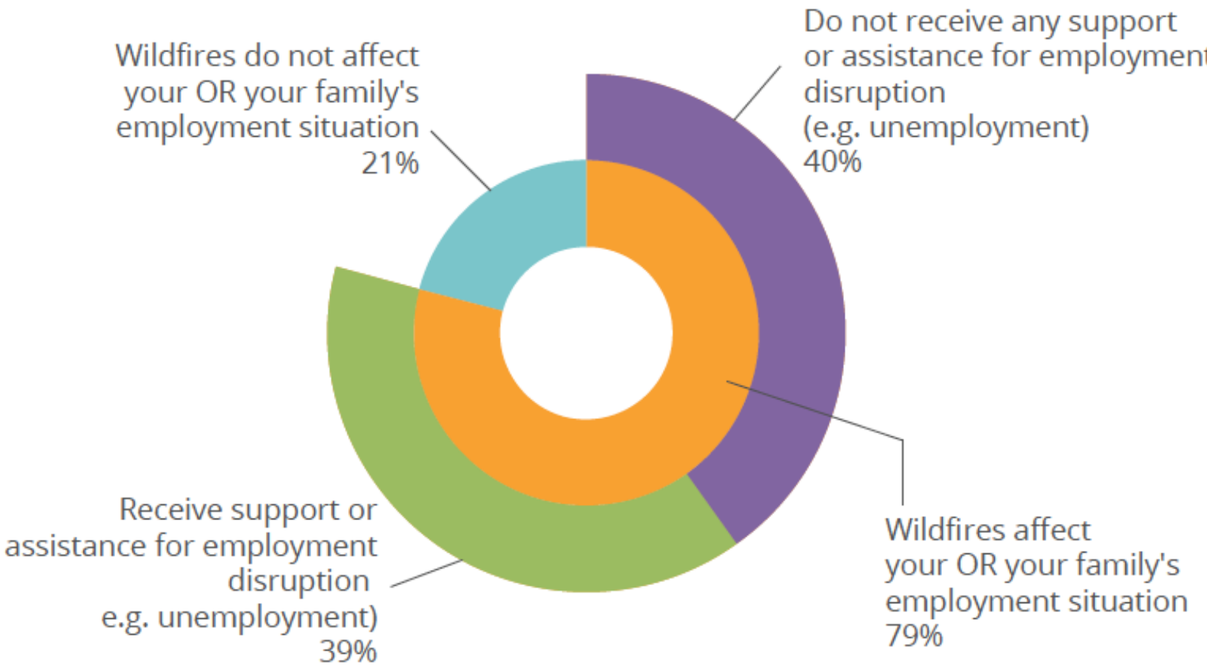
~74% of participants face a heightened risk of cardiovascular disease due to high blood pressure at elevated to hypertension levels. Up to 60% may suffer from poor lung health based on spirometry measures, with 40% with mild to severe lung obstruction.



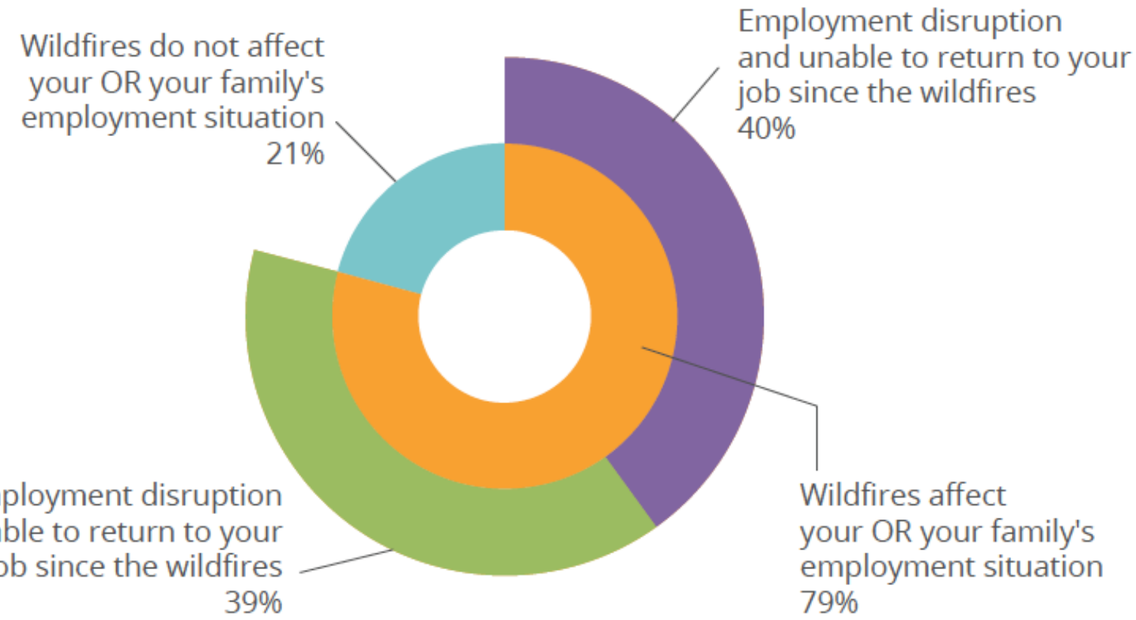
Post-fire Job and Income Loss

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

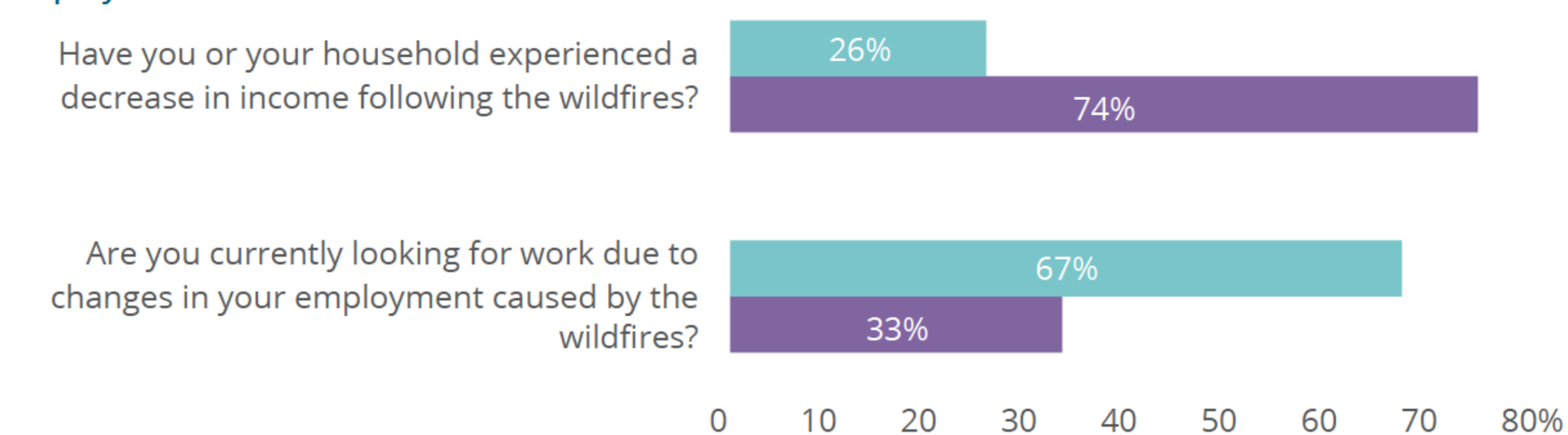
Did the wildfires affect your OR your family's employment situation? Did you receive support or assitance for employment disruption (e.g., unemployment)?



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

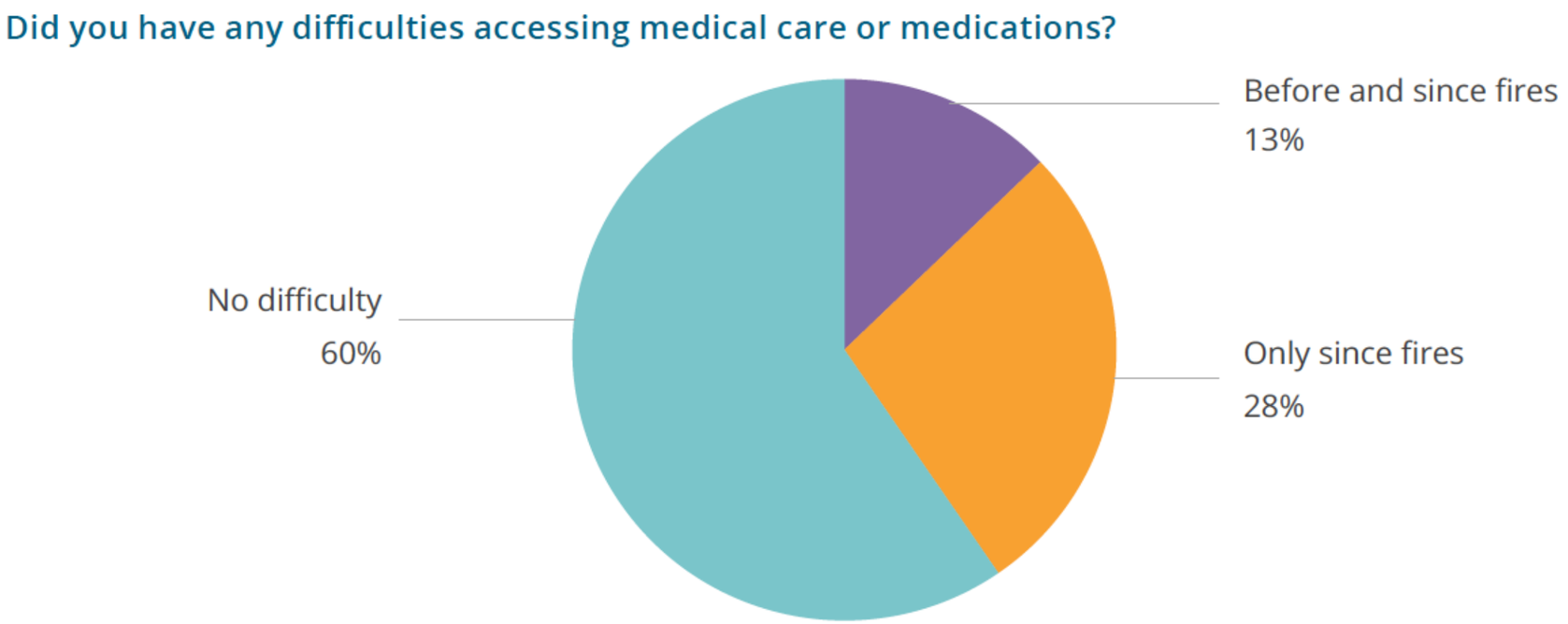


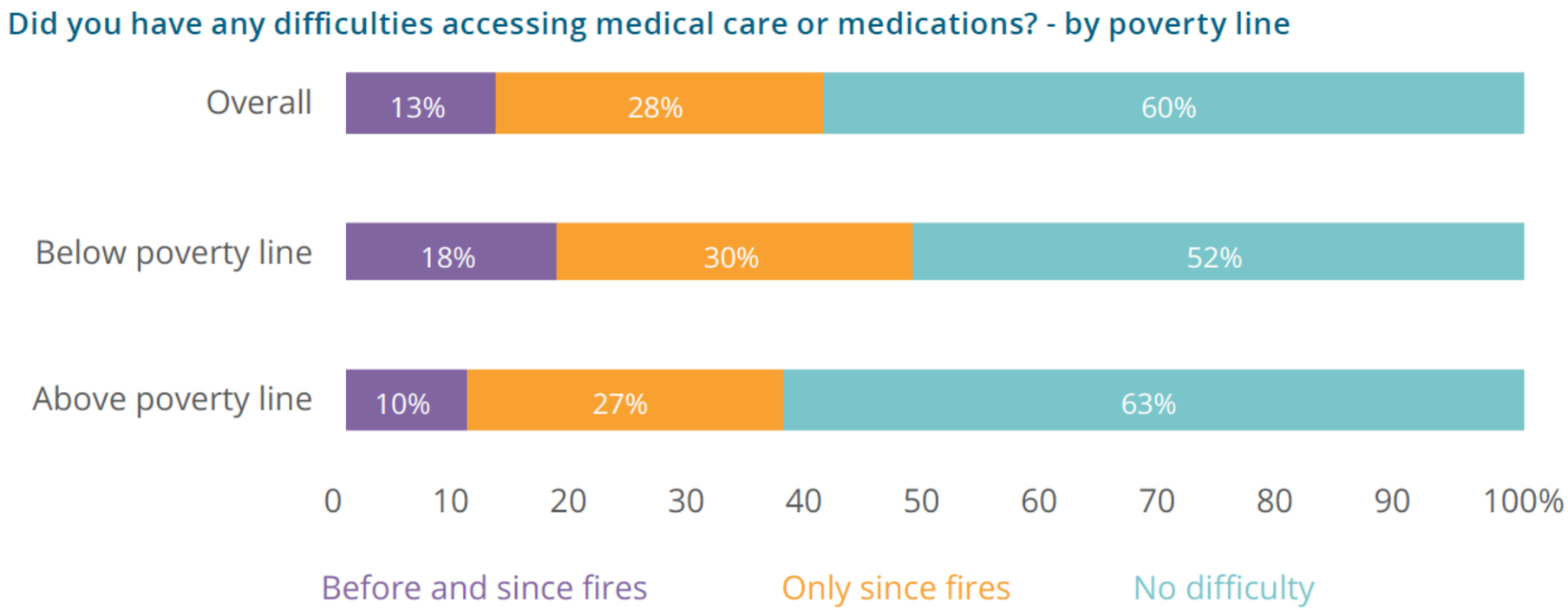
Employment effect of wildfires

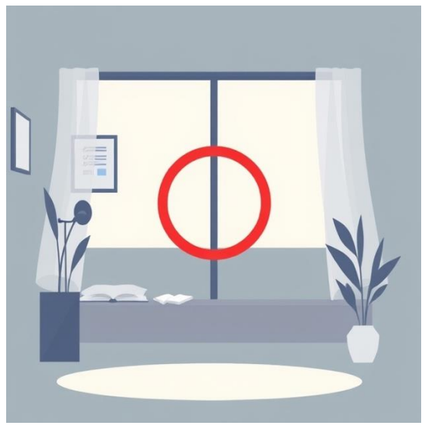


Increased Difficulty in Accessing Medical Care

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

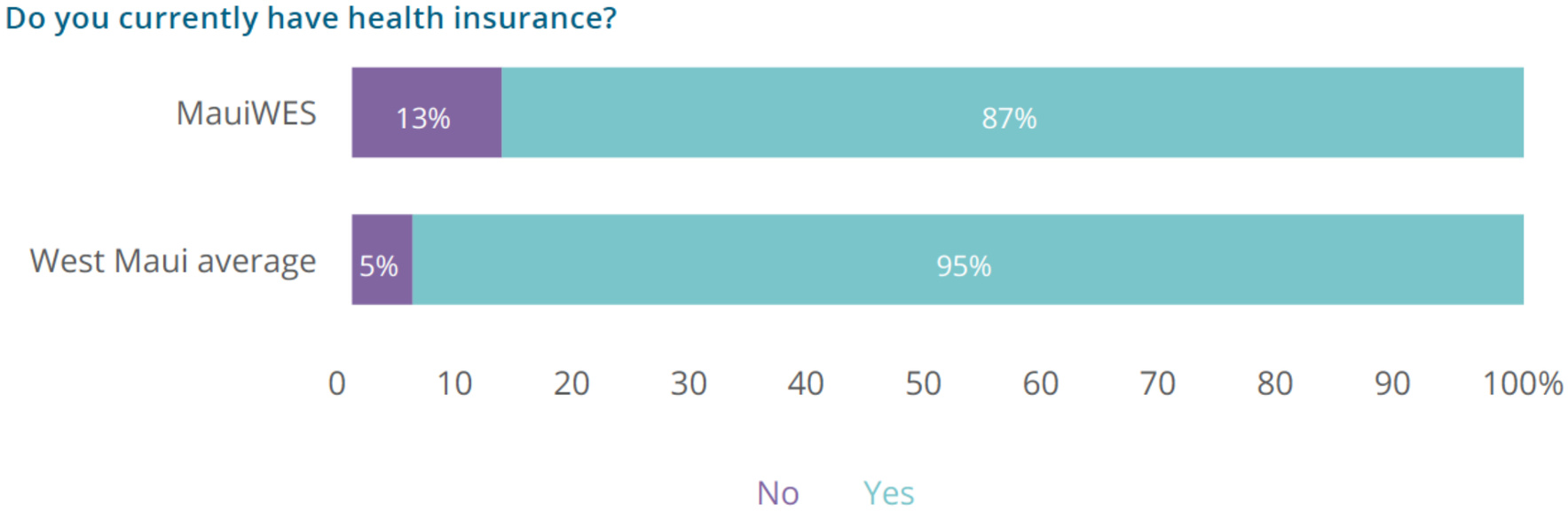


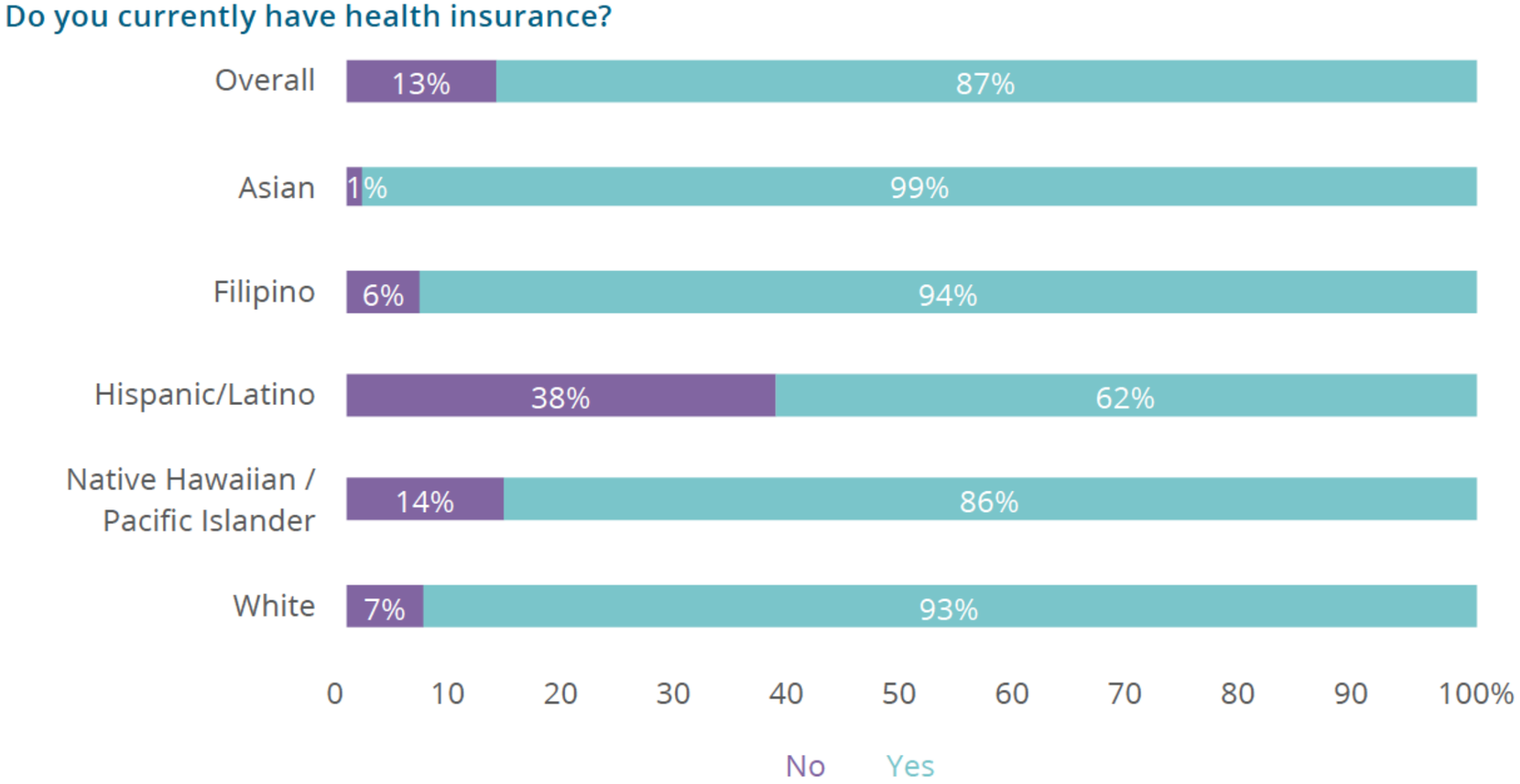




Post-fire Loss of Health Insurance Coverage

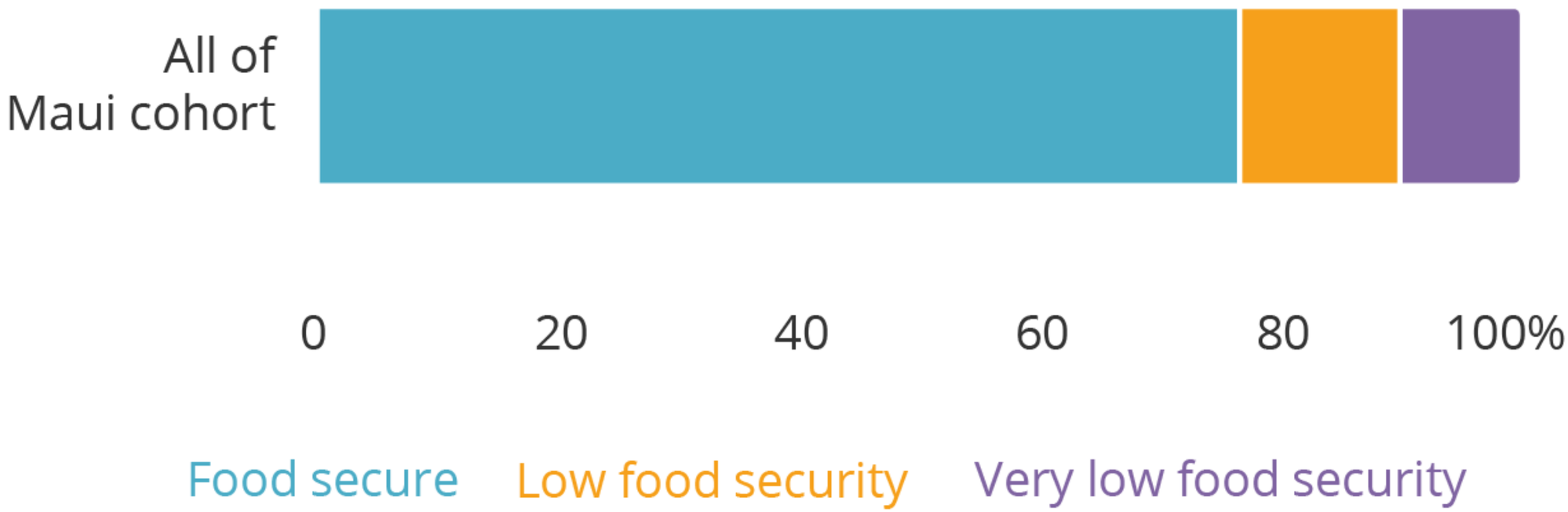
Significant disparities in health insurance coverage, with over 10% of participants lacking insurance, notably more than 38% among Hispanics.





Increased Food Insecurity

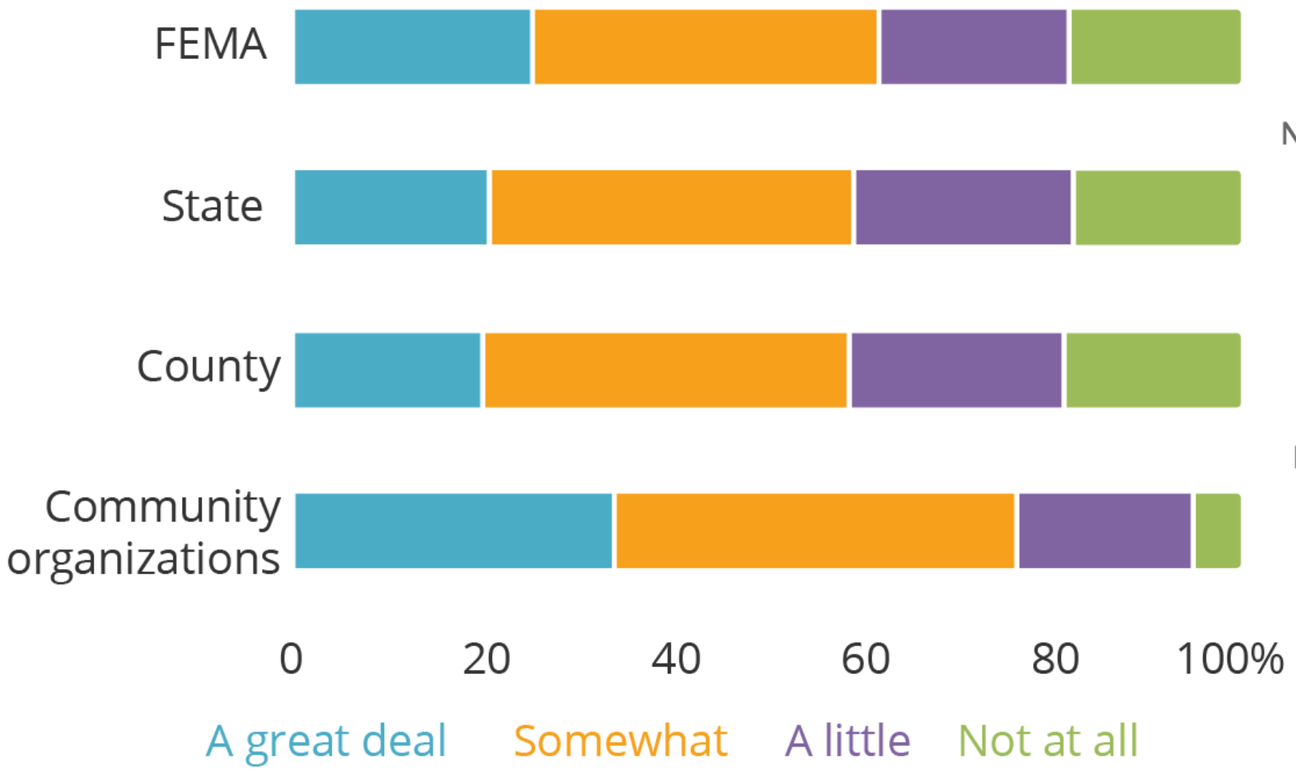
Almost half of respondents experienced very low or low food security. This is substantially higher than in the pre-fire UHERO Rapid Survey (all of Maui cohort) where < than ¼ of participants were food insecure.



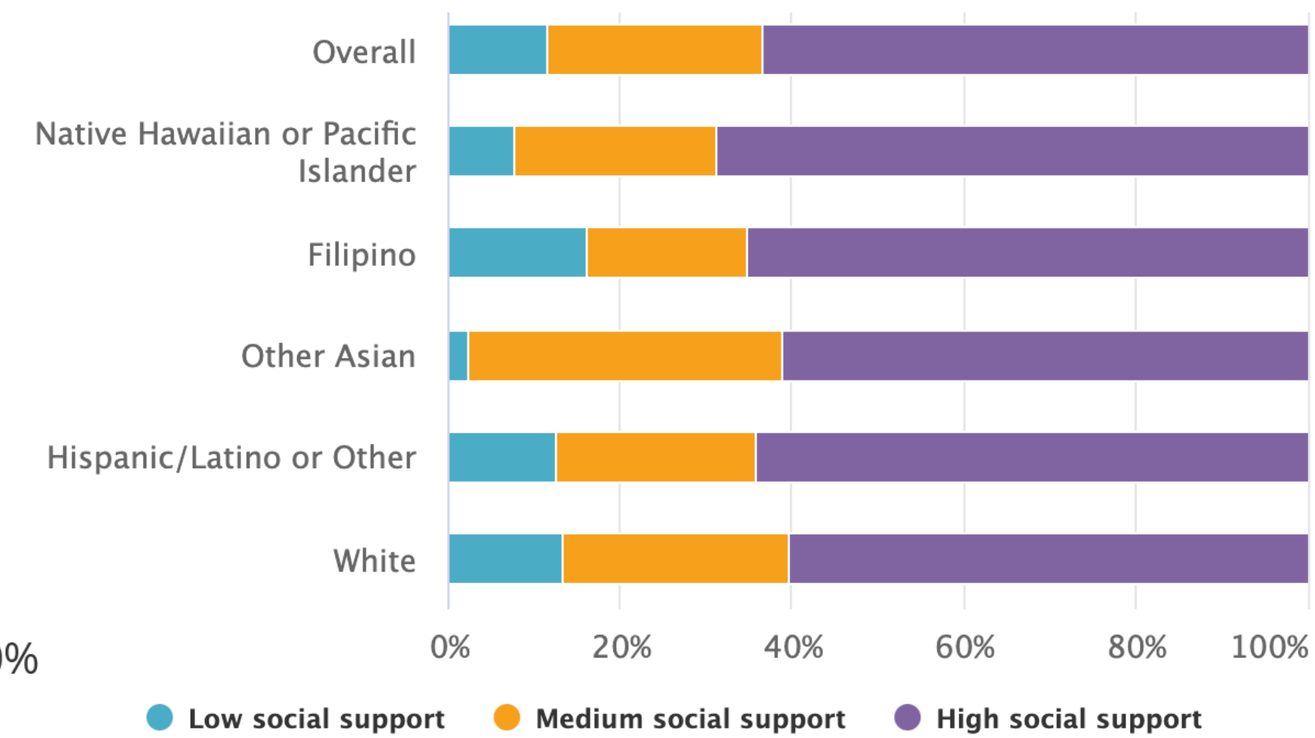
Resiliency - Trust and Social Connectedness

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

Trust in service providers



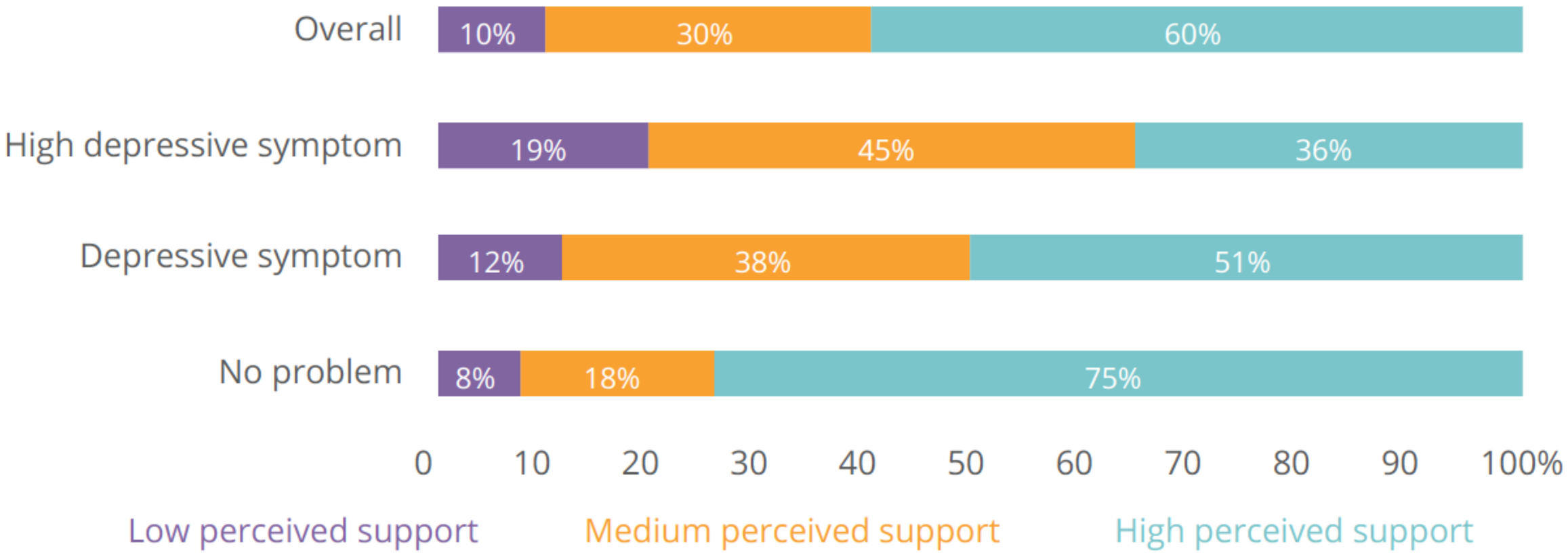
Variability by race/ethnic group



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



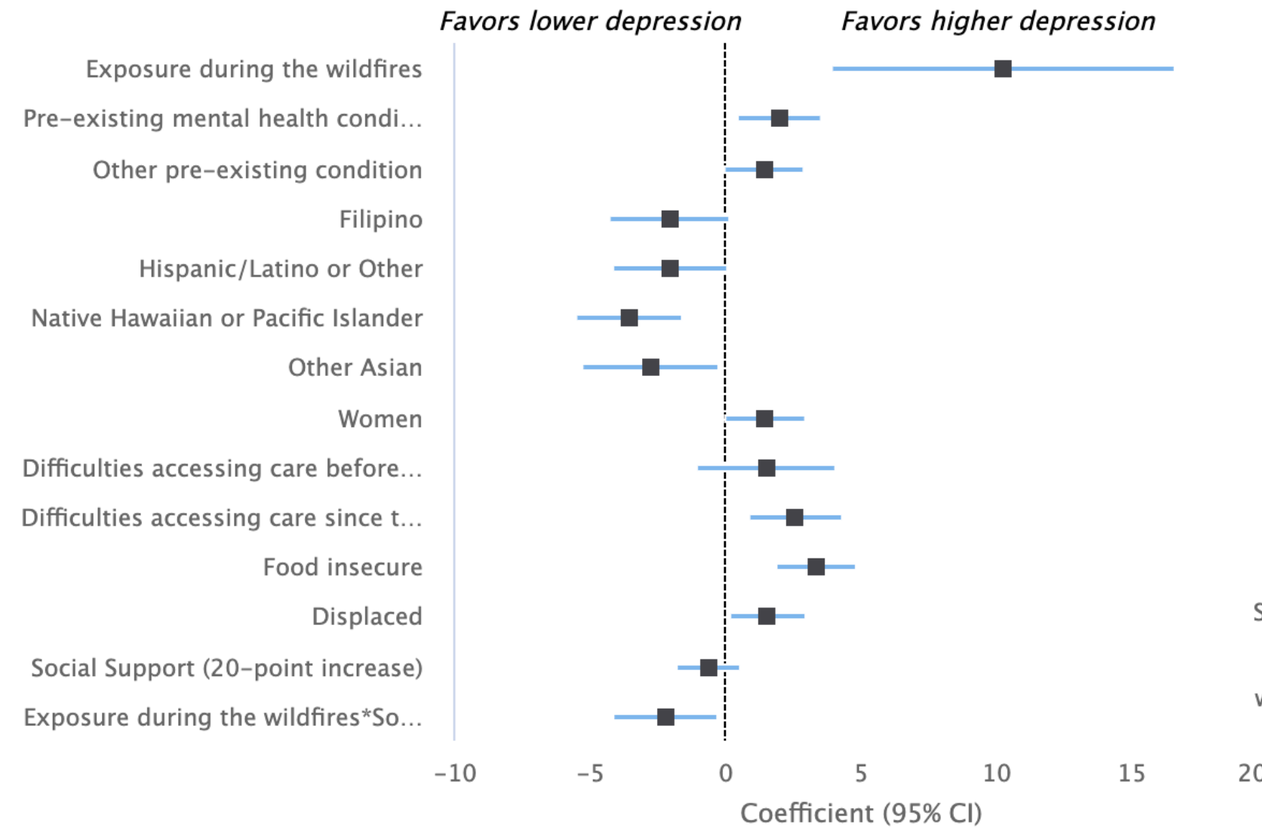
Interaction of Exposure on Mental Health & Social Factors

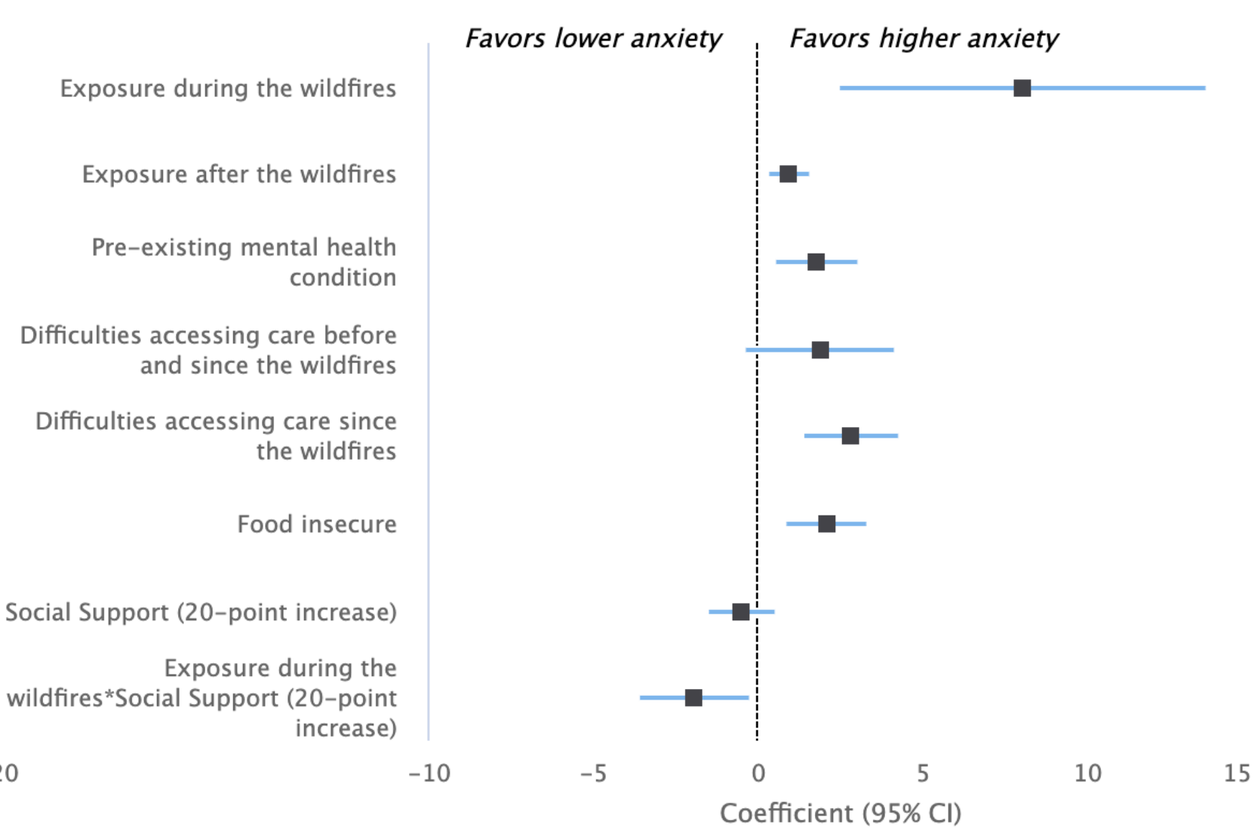
Risk factors:

- Wildfire exposure
- Pre-existing conditions
- Limited access to care
- Food insecurity
- Displacement

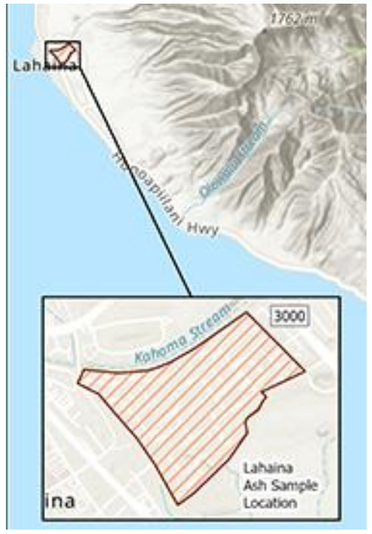
Protective factors:

- Social support generally
- Social support during fires





Inductively Coupled Plasma-Tandem Mass Spectrometry

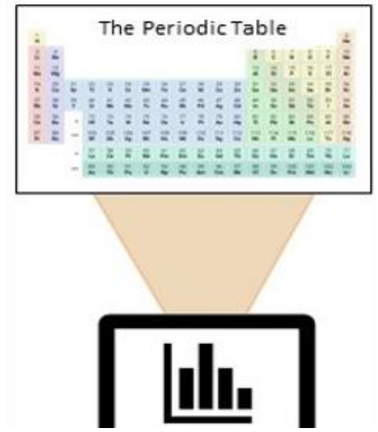


The ash samples were collected on November 7-8, 2023 from 100 properties in Lahaina, which had been constructed from the 1900s to the 2000s.

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

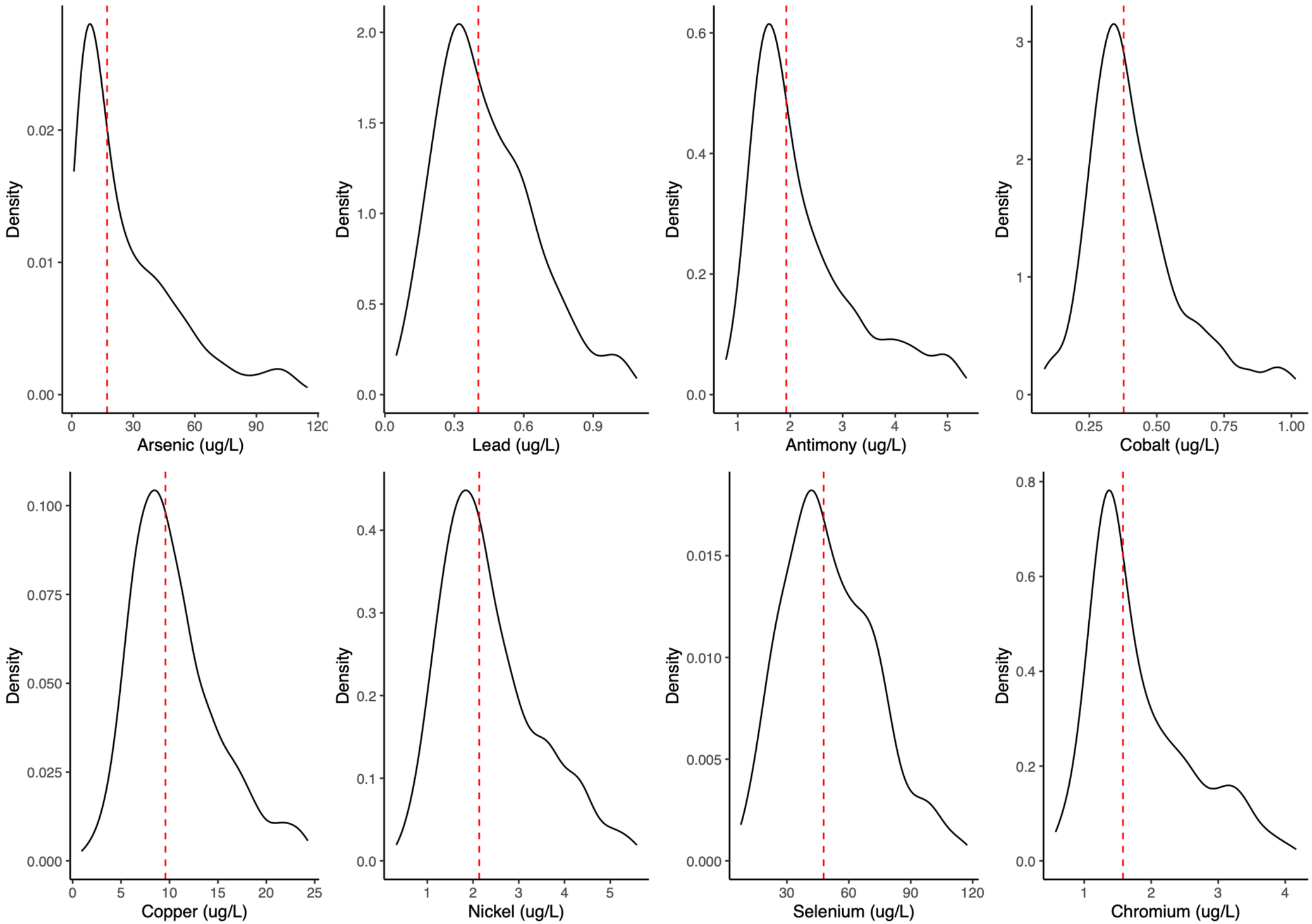
Urine Sample → Sample Processing → ICP-MS/MS Analysis → Data Integration



(Columbia Uni. Core)

Preliminary Heavy Metal Exposure Results from Urine

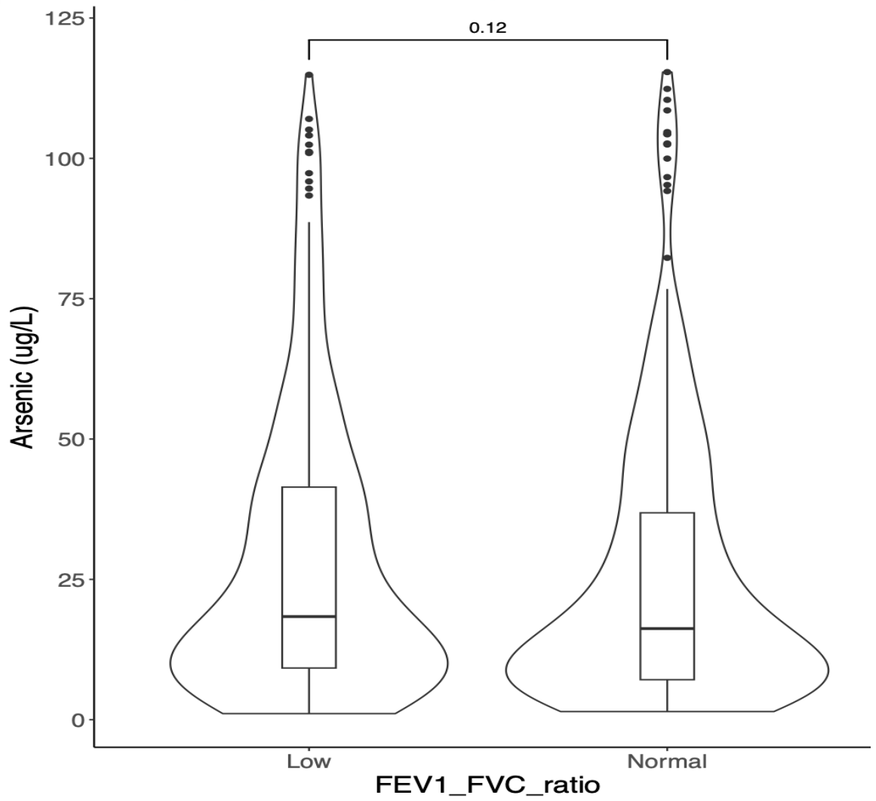
Performed heavy metal analysis for the first batch of samples (767). The distribution for Arsenic, Lead, Antimony, Cobalt, Copper, etc in urine samples:

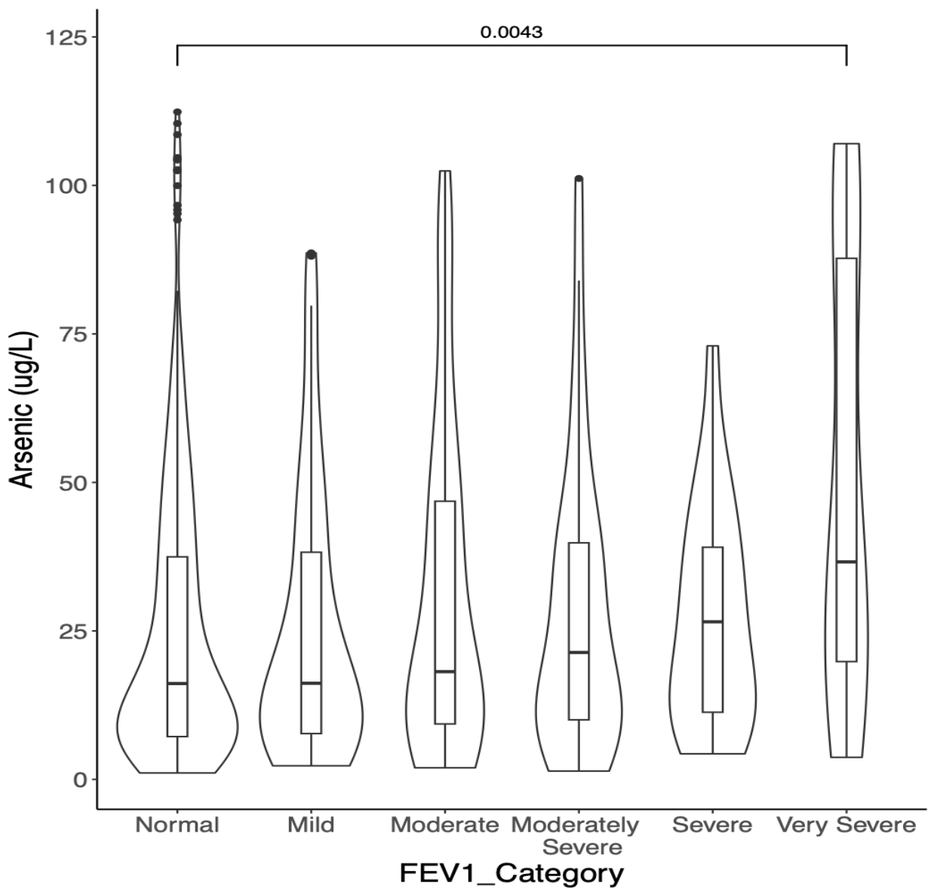


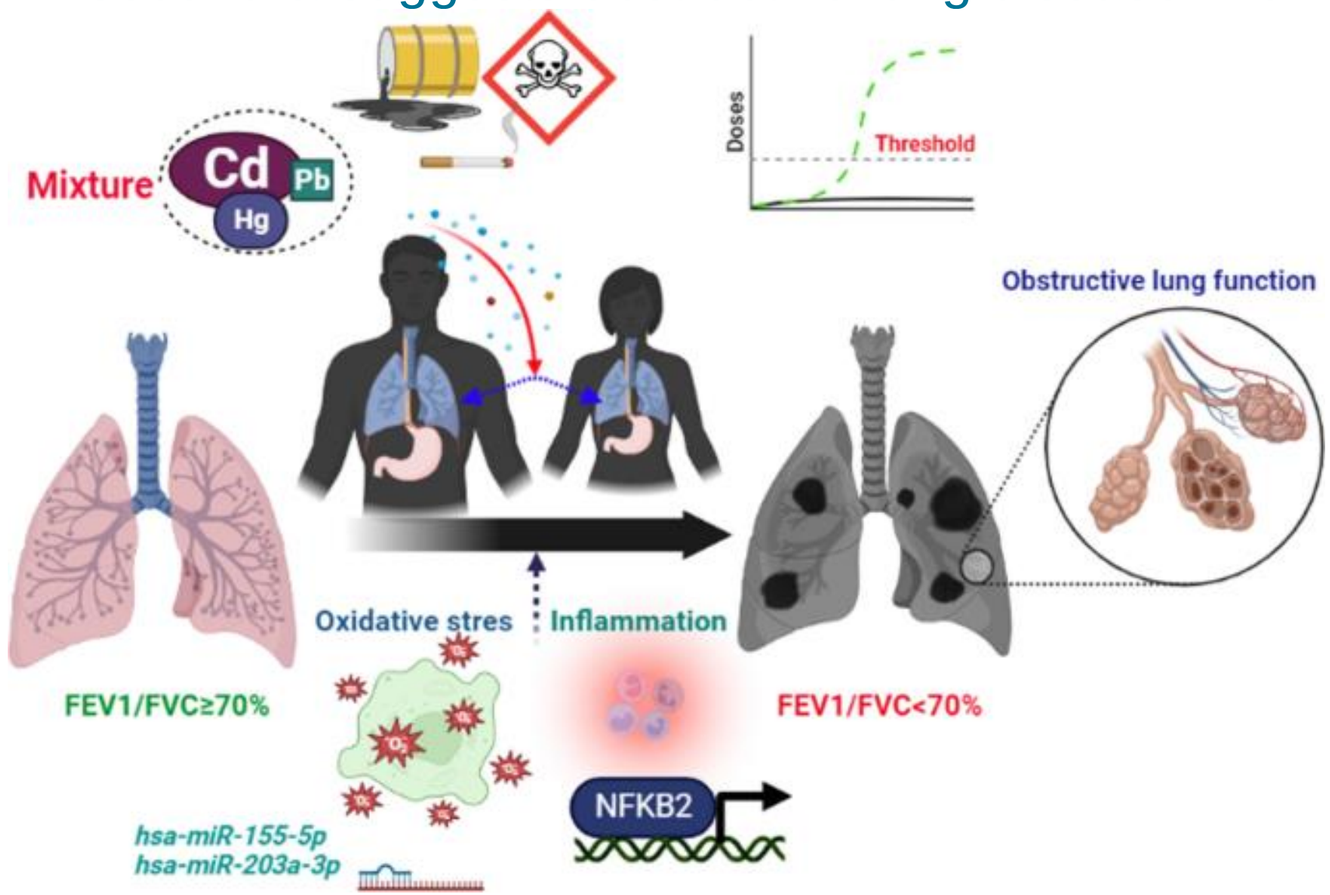
Preliminary results showed > 20% of participants with high levels of these metals.

High Levels of 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.







Nguyen, H.D. Effects of mixed heavy metals on obstructive lung function: findings from epidemiological and toxicogenomic data. *Environ Geochem Health* **45**, 8663–8683 (2023).

DOI:10.3389/fenvs.2019.00066

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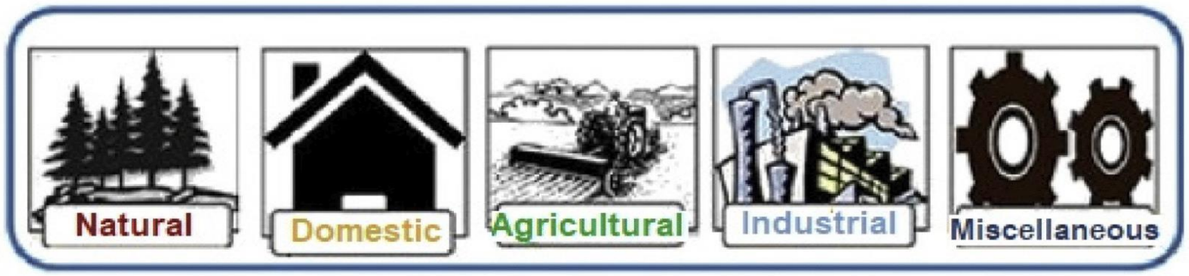
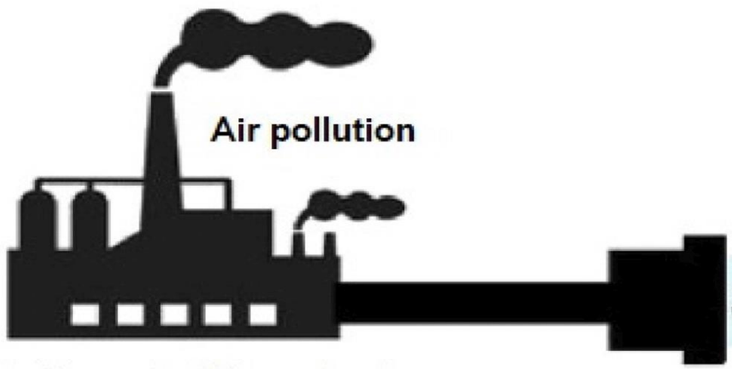
Heavy Metal Exposures From Cereal Crops



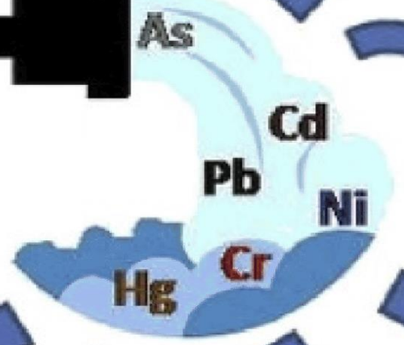
Sources of heavy metal contamination

Animal grazing on land irrigated with contaminated effluent

Additional exposure of HMs through organism's food or milk (dietary exposure)

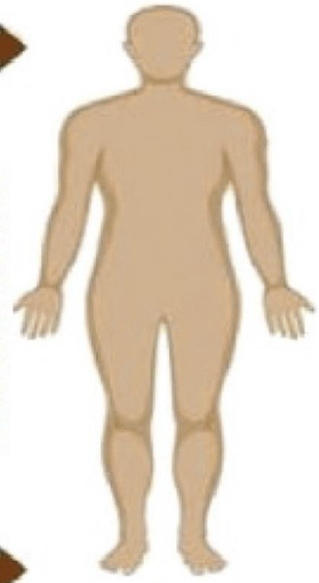


Industrial effluent discharge as a major source of heavy metal contamination

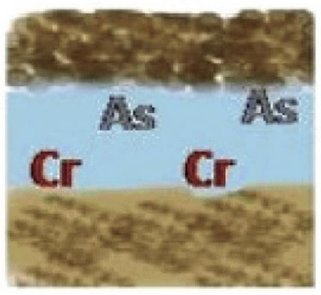


- Carcinogenicity
- Mutagenicity
- Genotoxicity
- Endocrine disruption
- Neurotoxicity
- Skin/eye irritation

Toxic hazards of HMs



Eutrophication disturb aquatic life, bioaccumulation of heavy metals in fishes



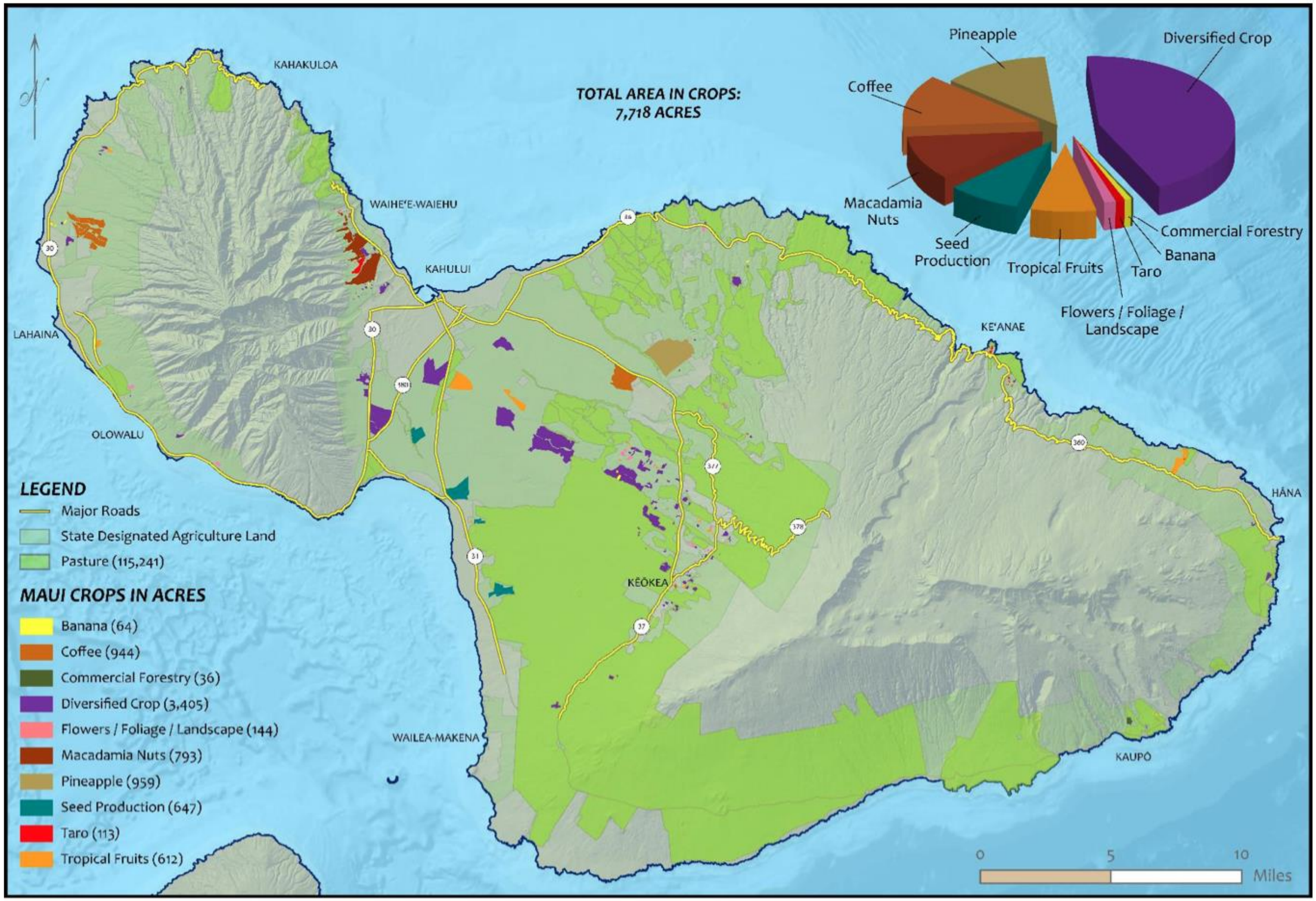
Groundwater pollution with HMs

Soil pollution with HMs, effluent used in crop irrigation

Additional exposure of HMs for smokers (soil-tobacco plant-cigarette-smokers)

Bioaccumulation of heavy metals in food chain

Agricultural Sources of Acute/Chronic Heavy Metal Exposures?



Department of Agriculture
STATE OF HAWAII

MAUI CROP SUMMARY (2020)

SDAV UH HILO

University of Hawai'i Hilo

John A. Burns School of Medicine

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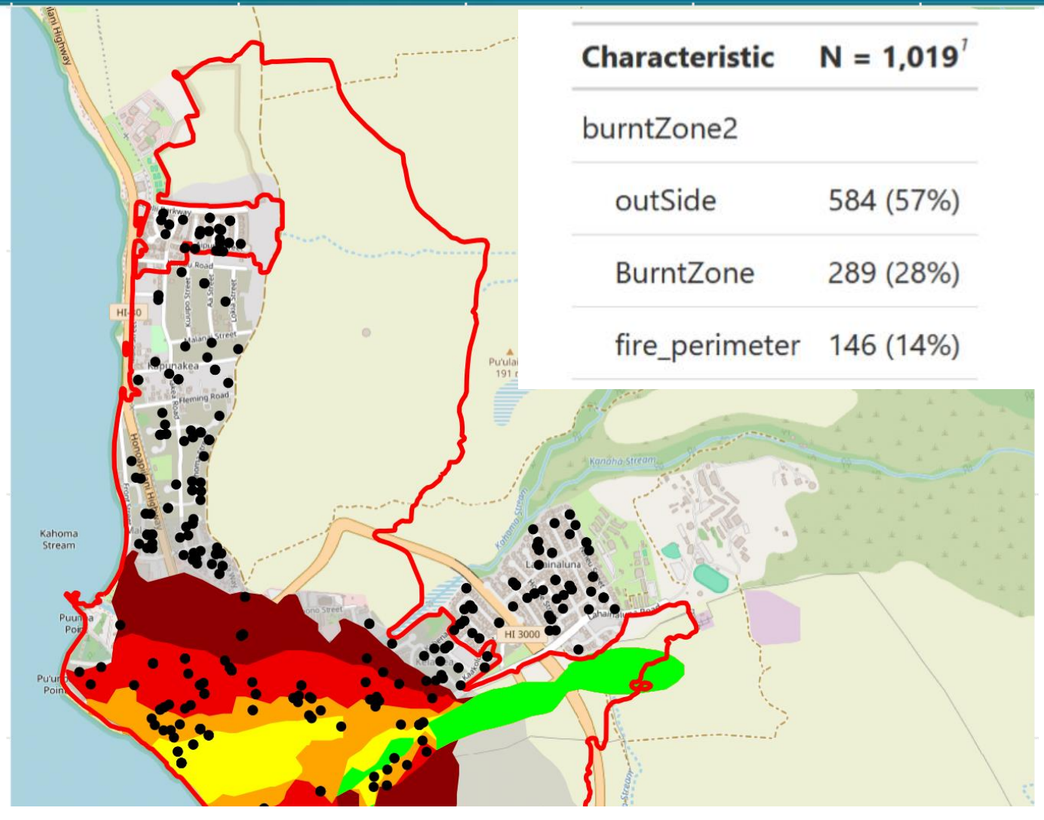
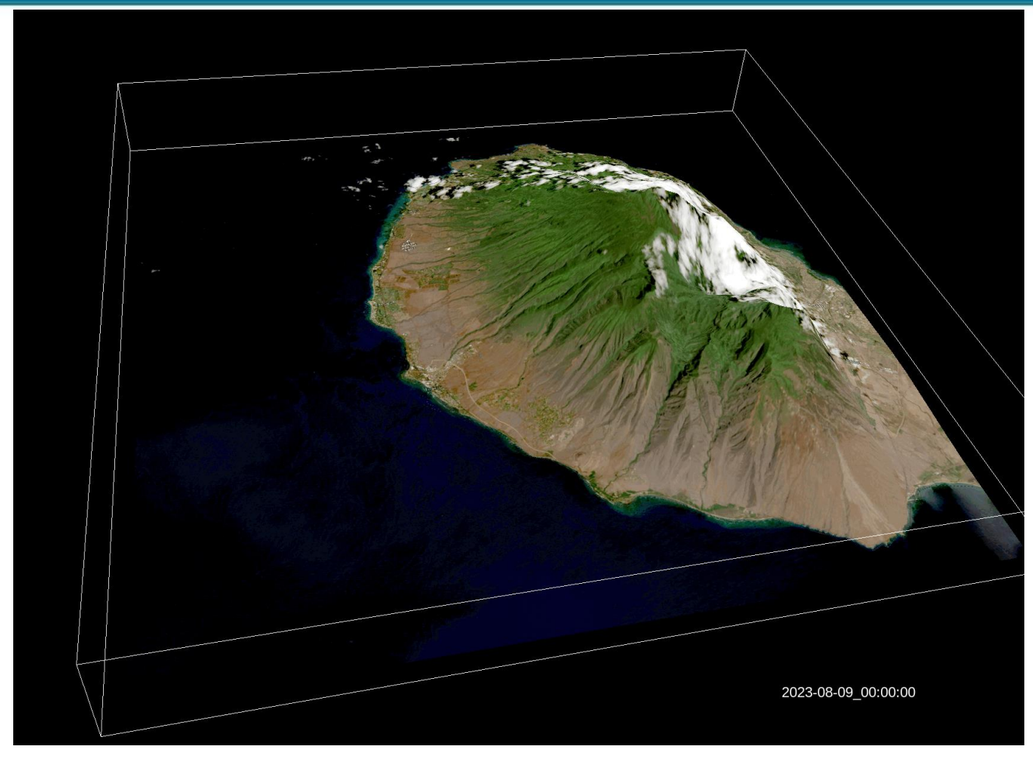
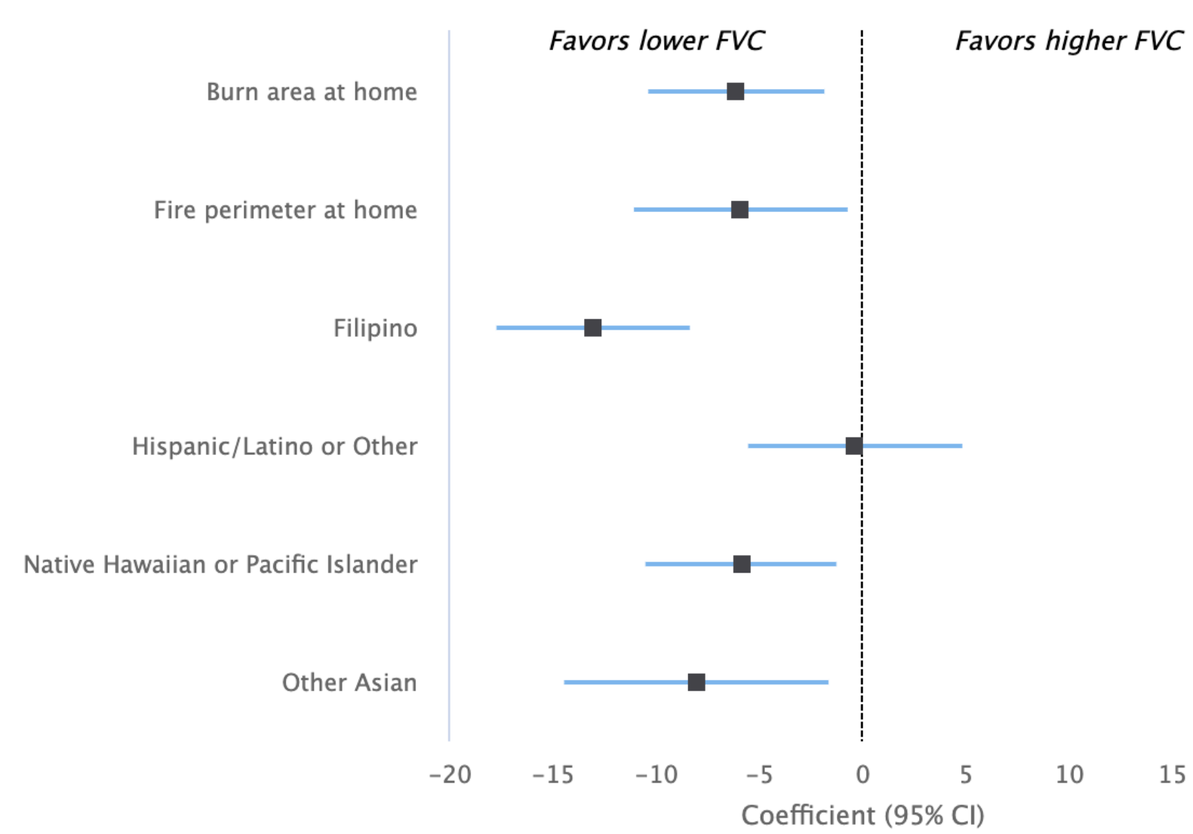
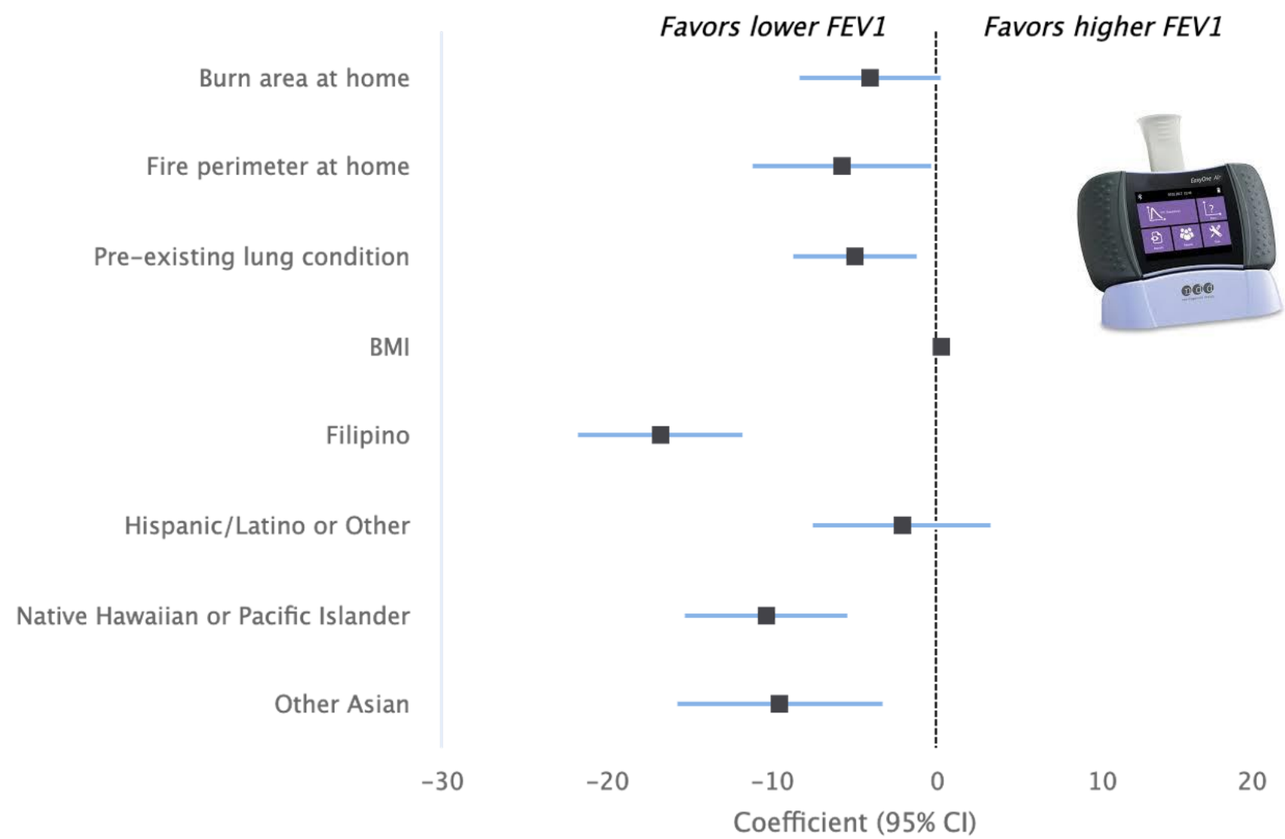
Acute Wildfire Exposure Exacerbates Poor Lung Health



Characteristic	N = 1,019[1]
burntZone2	
outSide	584 (57%)
BurntZone	289 (28%)
fire_perimeter	146 (14%)







Further analysis is ongoing, pending target recruitment.

JOHN A. BURNS SCHOOL of MEDICINE

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Six months follow-up: Individual-Level Impacts of MauiWES

Shared the results with family or friends	**48%**
Followed up with my healthcare provider	**41%**
Made lifestyle changes (e.g., diet, exercise, smoking cessation)	**38%**
Sought additional health screenings or consultations	**21%**
Used the dashboard to monitor my health progress	**19%**
Accessed mental health services	**16%**
Decided to take no further action	**14%**
Discussed my results with a community health worker	**9%**
Enrolled in health insurance or a support program	**8%**
Joined a community health program or event	**8%**

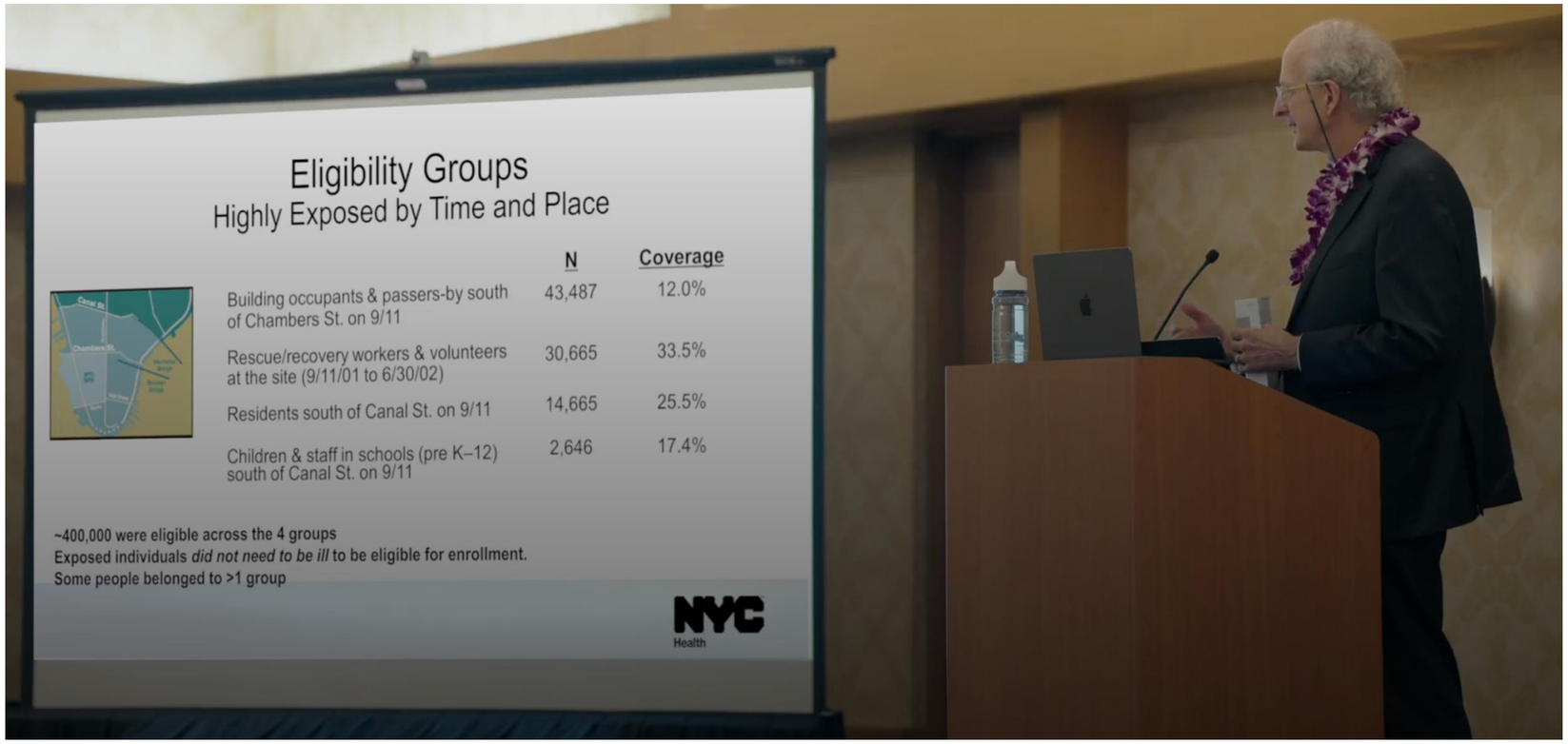
Community Dissemination to 1000+ at UHMC

MauiWES

Workshop with experts from other registries, communities & decision-makers

10+ national and international registries and long-term cohorts, including the World Trade Center Registry, Flint Registry, Katrina hurricane, etc.

Federal and State Partners, including CDC, FEMA, DOH, Gov Office OWR, etc.



All presentations available online: https://uhero.hawaii.edu/maui-wildfire-exposure-study-and-registry-workshop/

Where we are now: Finalizing health screenings for 2000+ participants

MauiWES

Where We Are Now: Building Registry

With added support from the State of Hawaii and NIH, we increased cohort target to **2,000** participants, including **children**, **first responders**, and **volunteers**.

Launched the MauiWES Registry for passive data collection, monitoring, and referral

MauiRegistry.com:

Now live, we are developing a comprehensive medical registry to facilitate information sharing and passive health monitoring through medical records (>10,000 affected).

Key Lessons & Immediate Needs in Maui

MauiWES

Key Learnings:

1.Contaminants Amplify Disparities: Legacy contaminants worsen health disparities, posing long-term risks for vulnerable populations.

2.Delayed Health Recovery: Basic needs like housing and food overshadow health, delaying care for vulnerable groups, including minorities and immigrants.

3.Community Trust Matters: Local organizations are vital for engaging and supporting affected populations.

Immediate Needs:

MauiRegistry.com: Support the enrollment of relocated participants in your district into the health registry to facilitate prevention and early intervention

Access to Care in Maui: Incentivize specialists (e.g., pulmonologists) and expand insurance programs for the uninsured.

Targeted Support: Provide culturally and linguistically appropriate resources for underserved communities.

Statewide Prevention: Preparing for Future Disasters

MauiWES

Legislative Action for Resilience: Invest in Health Resilience

1. Screening and Monitoring for Prevention:

- Launch a statewide health screening initiative to detect legacy contaminants (lead, arsenic, etc.) and health vulnerabilities in disaster-prone regions to enable prevention.

2. Integrated Disaster Preparedness:

- Develop comprehensive preparedness strategies integrating health with other social determinants, such as housing.

3. Invest in Healthcare Access Statewide:

- Support policies that expand healthcare access, incentives for healthcare workers in underserved areas, and expand health insurance for underinsured populations

Mahalo to Our Partners and Funders

Hawai'i Community Foundation
MAUI STRONG FUND

MauiWES

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