University of Hawai‘i

Maui Wildfire Exposure Study

Ruben Juarez, PhD
HMSA Professor in Health Economics
College of Social Sciences
UHERO &
Dept. of Economics

Alika Maunakea, PhD
Professor
John A. Burns School of Medicine
Dept. of Anatomy, Biochemistry & Physiology

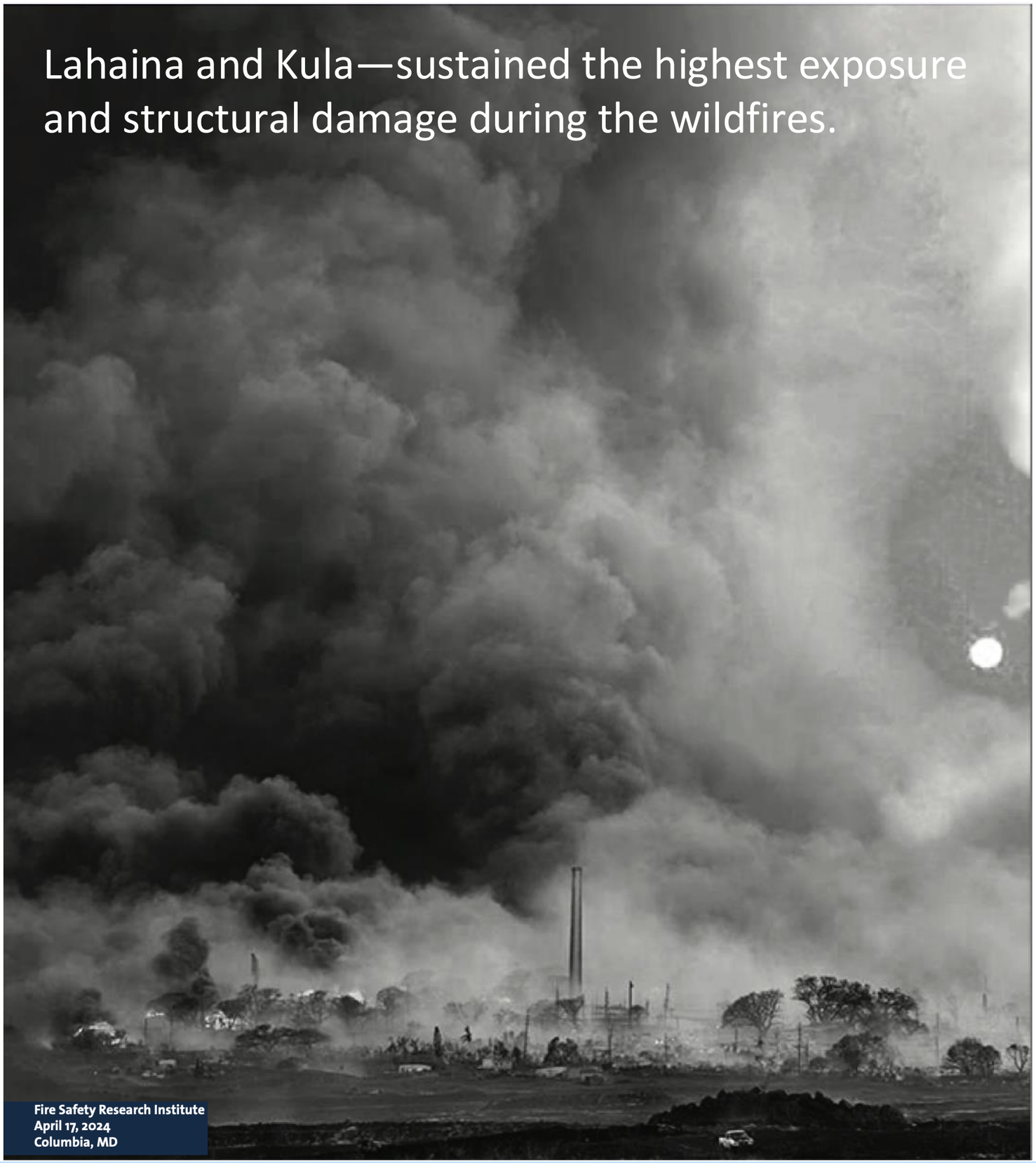
Christopher Knightsbridge, PsyD
Mental Health Team
MauiWES & Lahaina Comprehensive Health Center

MauiWES.org

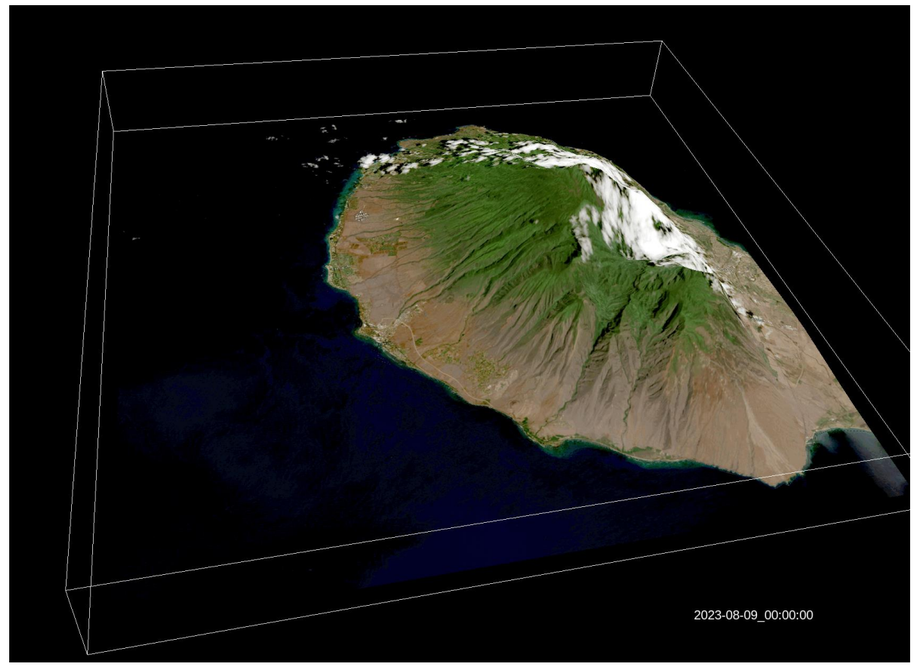
State of Hawaii & NIH R61MD019793

Acute Impact of the August 2023 Maui Wildfires

Lahaina and Kula—sustained the highest exposure and structural damage during the wildfires.



Fire Safety Research Institute
April 17, 2024
Columbia, MD



Drs Businger & Moisseeva (SOEST, UHM)

Lahaina

ESTIMATED EXPOSURE

- **2,719** structures exposed
- **2,170** acres burned
- **2,207** structures damaged or destroyed
- **$5.52 Billion** capital exposed

Capital exposure is the estimated cost to rebuild.

ESTIMATED BUILDING EXPOSURE

- **86%** Residential
- **1.1%** Unclassified
- **0.4%** Agricultural
- **9%** Commercial
- **1.0%** Industrial
- **0.1%** Government
- **2.4%** Educational
- **0.5%** Assembly

BREAKDOWN OF POTENTIAL NEEDS

- **4,500** sheltered population
- **3,560** gallons of water per day
- **9,000** MRE (meals ready to eat) per day
- **51,700** square feet of shelter
- **450** 25-gallon waste bins

Needs estimates are based on the estimated sheltered population.

Kula

ESTIMATED EXPOSURE

- **544** structures exposed
- **678** acres burned
- **$434 Million** capital exposed

Capital exposure is the estimated cost to rebuild.

ESTIMATED BUILDING EXPOSURE

- **96%** Residential
- **2%** Agricultural
- **2%** Unclassified

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.

Maui Wildfire Exposure Study (MauiWES) - Team

COMMUNITY
ADVISORY BOARD

HISPANIC CHAMBER OF COMMERCE HAWAII

ROOTS REBORN

HCIR HAWAI'I COALITION FOR IMMIGRANT RIGHTS

MĀLAMA KULA

MAUI MEDIC HEALERS HUI

Papa Ola Lōkahi

healthymothers healthybabies COALITION OF HAWAII

HUI NO KE OLA PONO

MauiWES

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HEALTH POLICY INITIATIVE

HAWAII STATE DEPARTMENT OF HEALTH

VARIOUS DOCTORS AND PARTNERS FROM MAUI

FUNDING PARTNERS

HAWAI'I COMMUNITY FOUNDATION

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

STATE OF HAWAII 1959

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

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COLLEGE OF SOCIAL SCIENCES University of Hawai'i at Mānoa

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Hawai'i Integrated Analytics

TAGNAWA FOR MAUI

MANY OTHERS

Academic-Community Partnership

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UHERO

Survey, Biomonitoring, and Health Screening

Data Components

Questionnaires

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

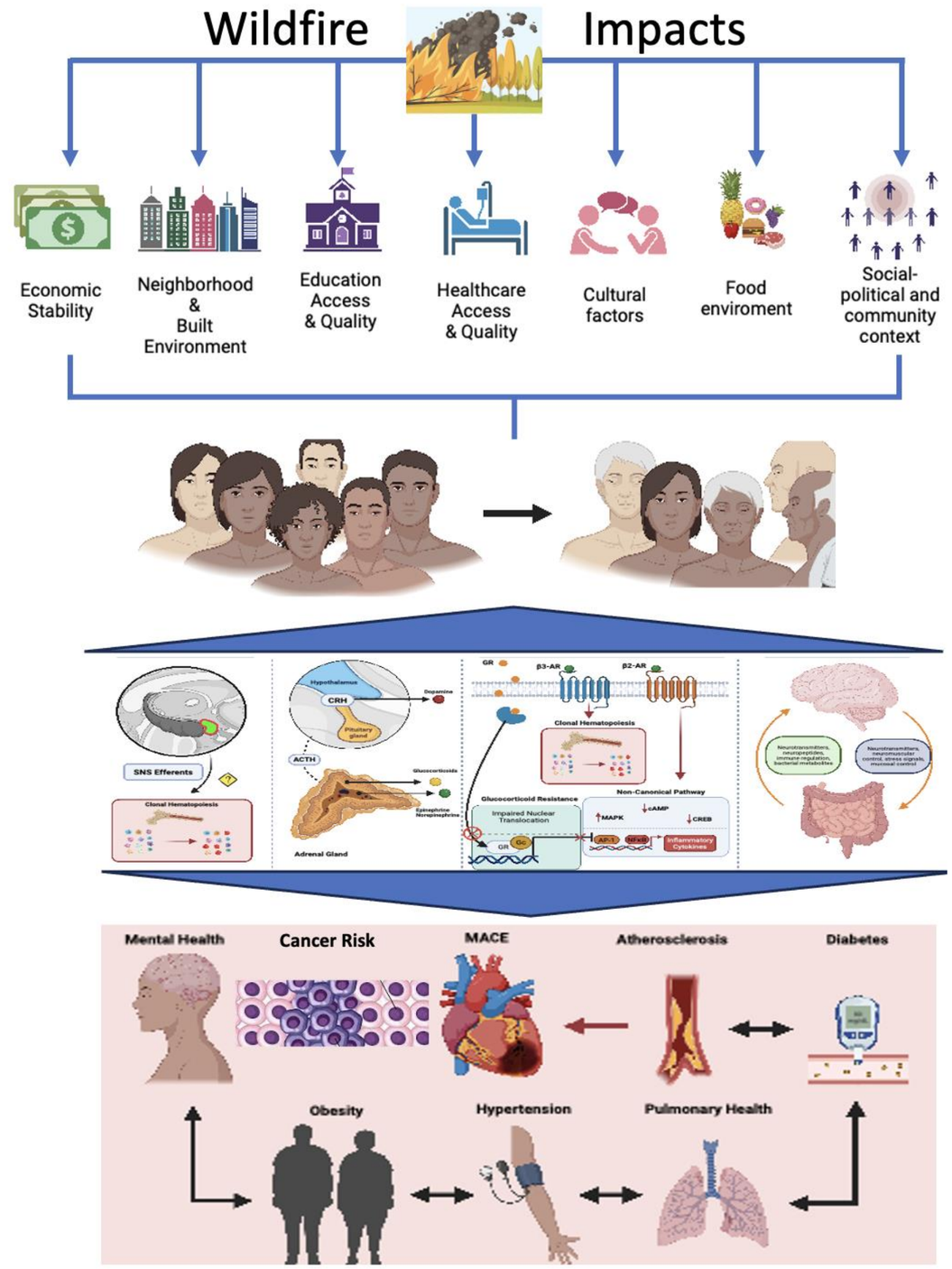
Biospecimens

- Stress Response
- Inflammation
- Environmental Toxicants

Health Exam

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

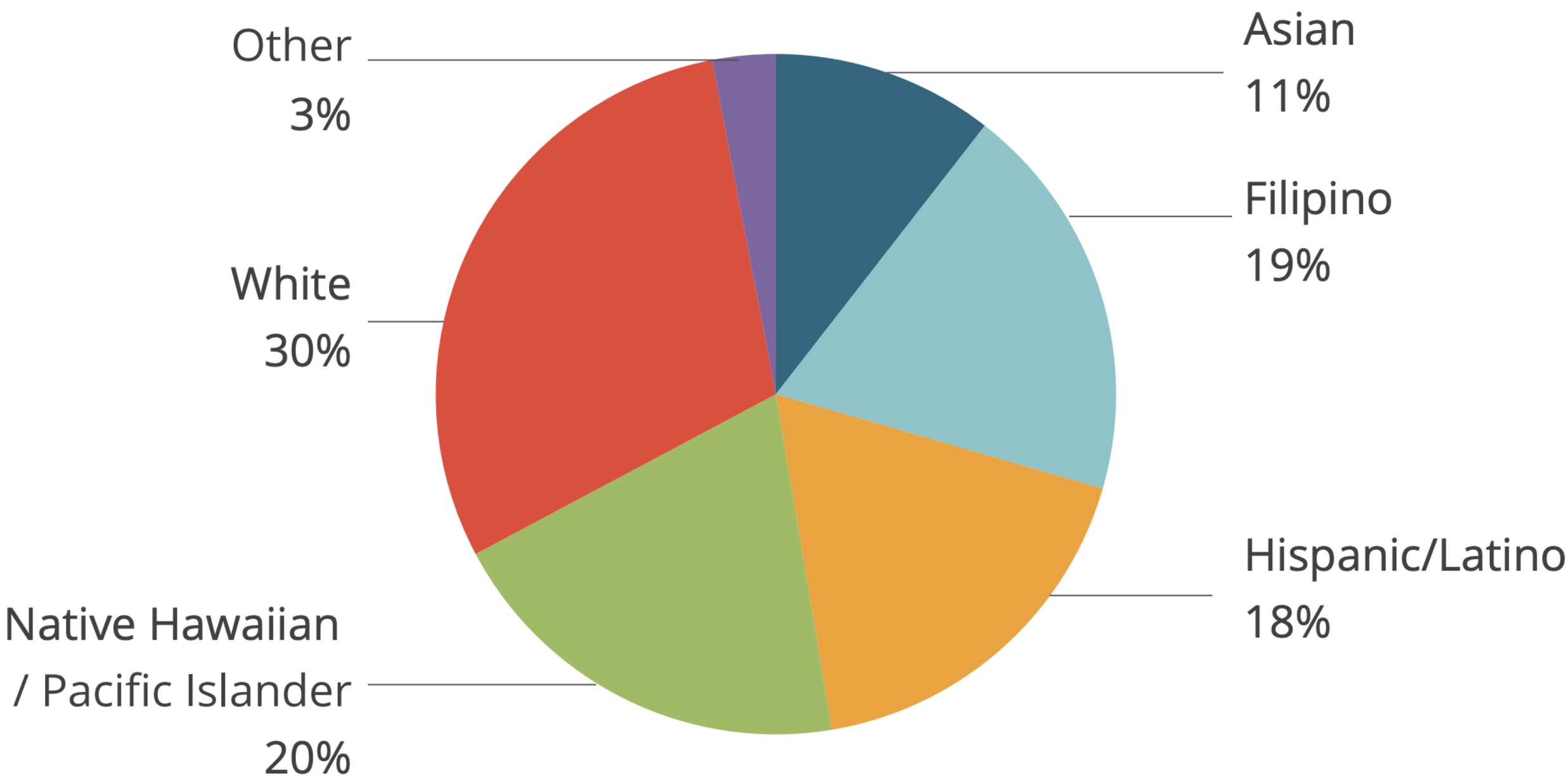
Participant Involvement



Jan. 2024 – Jan. 2025: First health screen since fires for many.

Cohort size: 2000+ adults and children (10-17 y/o).

Diverse Cohort Representative of Impacted Population

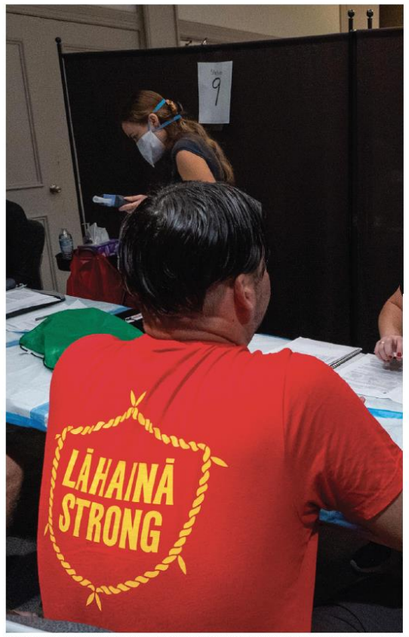


This is the most comprehensive and ethnically diverse study to evaluate short- & long-term health following a natural disaster in Hawai‘i.

YEAR 1: MauiWES Main Findings for Adults

Main trends identified:

1. Elevated rates of mental and physical health conditions
2. Persistent barriers to accessing healthcare services
3. Widespread housing instability, unemployment, and food insecurity
4. Concerning levels of exposure to heavy metals and environmental contaminants



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 HAWAI'I MĀNOA

MauiWES

JAMA Network | Open

Original Investigation | Public Health

Health and Social Support in the Aftermath of the Maui Wildfires

Ruben Juarez, PhD; Krit Phanikitnirundorn, PhD; Samia Valeria Ozorio Dutra, PhD, RN; Daniela Bond-Smith, PhD; Alison G. Lee, MD, MS; Alika K. Maunakea, PhD

YEAR 2: MauiWES Findings For Keiki and Adults

Main trends identified:

1. Small but measurable improvements in mental health for adults
2. Self-rated health is getting better for adults
3. Uninsured rate cut by a third yet some remaining gaps in access to care remaining
4. Elevated rates of mental and physical health conditions for *keiki*

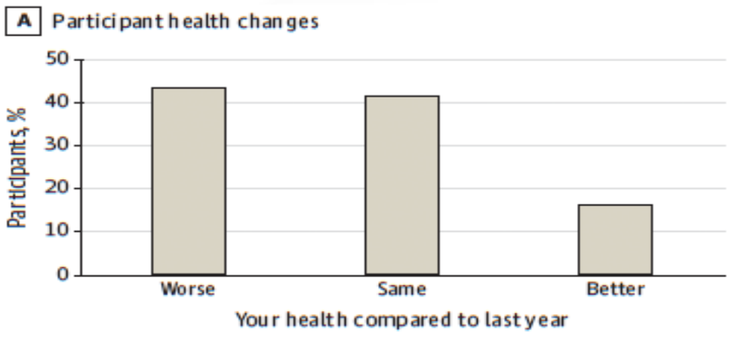
UHERO
THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAI'I

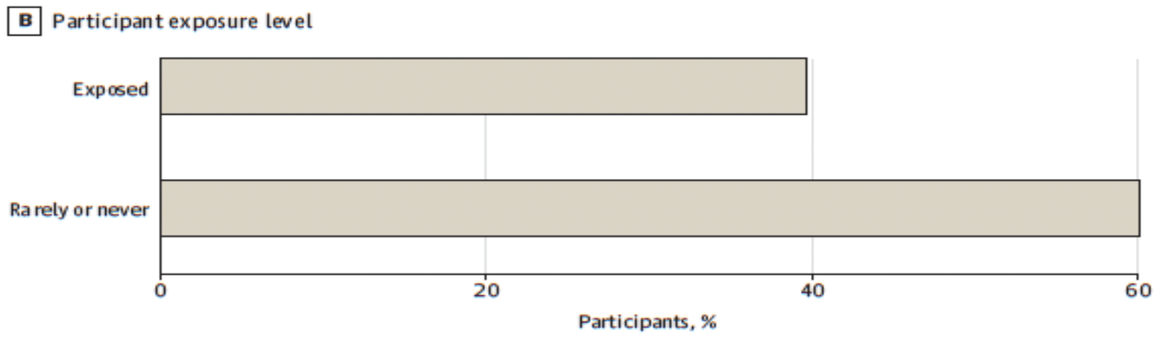
UHERO PUBLIC HEALTH REPORT

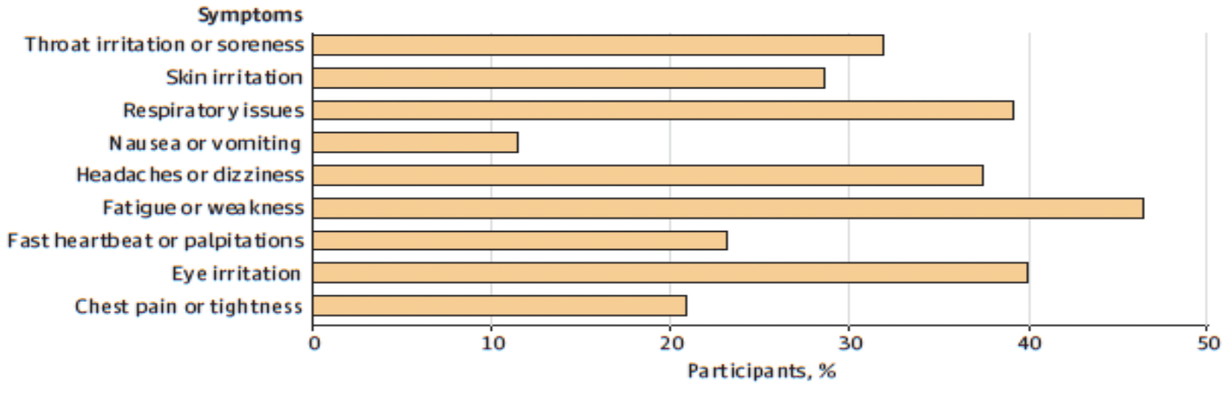
FROM CRISIS TO RECOVERY: HEALTH AND RESILIENCE TWO YEARS AFTER THE MAUI WILDFIRES

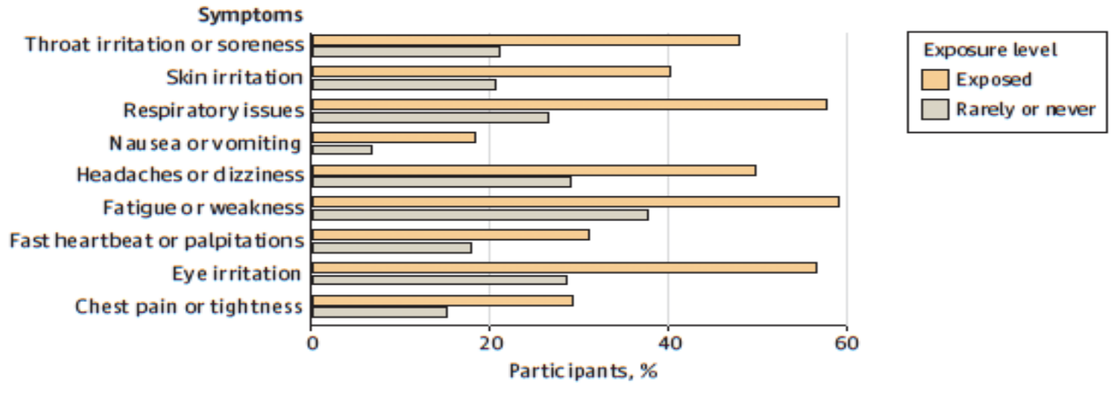
JUNE 18, 2025

Physical Health in the Aftermath: Adults







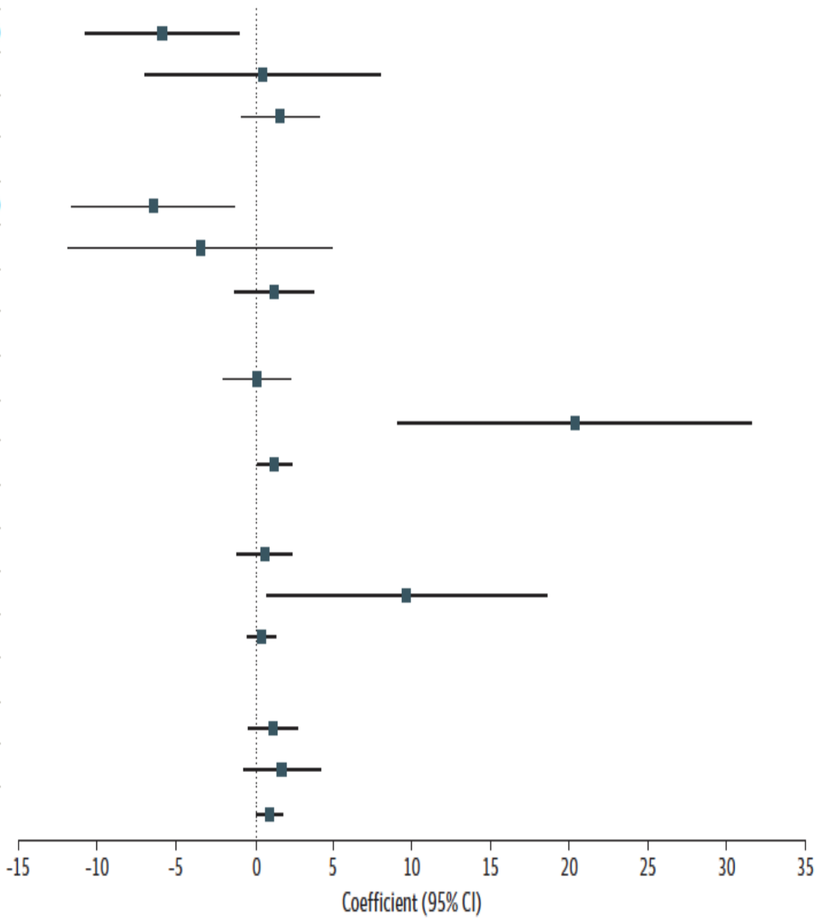


- ~ **Half** of participants reported their health **worsened** post-fires.
- **40%** reported direct or frequent wildfire **exposure**.
- **Exposed individuals** reported **2× higher rates** of common associated symptoms.
- **Chronic Disease Burden:** 42.9% of adults reported hypertension; 21.4% reported diabetes; 27.5% had high cholesterol; 9.1% had heart disease.
- **Respiratory Health:** 25% of adults showed low FEV_1 (indicative of impaired lung function); 17.5% had respiratory symptoms in the two weeks prior to the survey
- **Other Notable Conditions:** 19.3% reported gastrointestinal symptoms; 19.2% reported skin problems such as rashes, burns, or irritation.
- **New or Worsening Diagnoses (Post-Wildfire):** ~ 12% reported receiving a new diagnosis or experiencing worsening of a chronic condition since the fires.

Ongoing Health Issues From Exposure: Adults

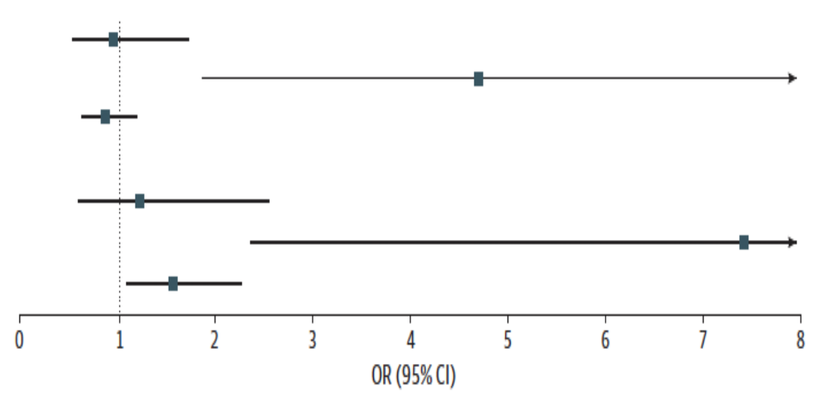
A Outcome by exposure variable

Exposure variable	Coefficient (95% CI)
FEV_1	
Fire perimeter status: inside	-5.97 (-10.81 to -1.14)
Acute exposure score	0.36 (-7.08 to 7.81)
Postwildfire exposure score	1.45 (-1.01 to 3.91)
FVC	
Fire perimeter status: inside	-6.58 (-11.73 to -1.43)
Acute exposure score	-3.62 (-11.94 to 4.71)
Postwildfire exposure score	1.10 (-1.40 to 3.60)
Days affected by health issues	
Fire perimeter status: inside	-0.02 (-2.16 to 2.12)
Acute exposure score	20.03 (8.87 to 31.18)
Postwildfire exposure score	1.10 (0.01 to 2.19)
Depression	
Fire perimeter status: inside	0.47 (-1.29 to 2.22)
Acute exposure score	9.43 (0.61 to 18.25)
Postwildfire exposure score	0.29 (-0.60 to 1.17)
Anxiety	
Fire perimeter status: inside	0.99 (-0.55 to 2.54)
Acute exposure score	1.57 (-0.88 to 4.01)
Postwildfire exposure score	0.84 (0.02 to 1.65)



B Outcome by exposure variable

Exposure variable	OR (95% CI)
Any physical symptoms	
Fire perimeter status: inside	0.92 (0.51 to 1.67)
Acute exposure score	4.54 (1.79 to 11.90)
Postwildfire exposure score	0.84 (0.60 to 1.15)
Respiratory symptoms	
Fire perimeter status: inside	1.18 (0.57 to 2.46)
Acute exposure score	7.18 (2.28 to 24.00)
Postwildfire exposure score	1.51 (1.05 to 2.19)



Lung Function Significantly Reduced

- People inside the burn zone had marked declines in lung function (FEV_1 and FVC), indicating impaired respiratory health.

Exposure Strongly Linked to Health

- High levels of acute exposure were associated with: **+20 more days** affected by health issues over the year; **9x higher depression** scores; **7x greater odds** of respiratory symptoms.

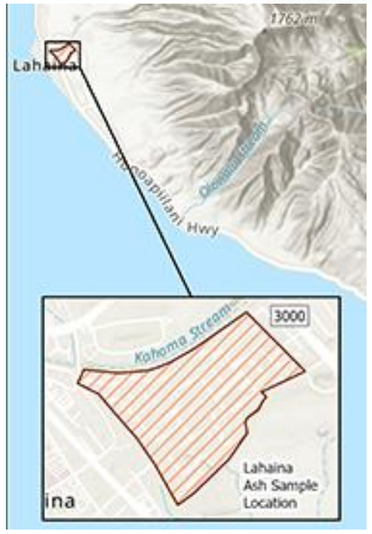
Ongoing Postfire Exposure is Linked to:

- More days with health issues; **1.5x higher odds** of respiratory symptoms.

Mental Health Affected

- Depression scores increased with exposure; Anxiety trended to an increase.

Urinalysis of Heavy Metals Implicated in Wildfire Ash/Smoke



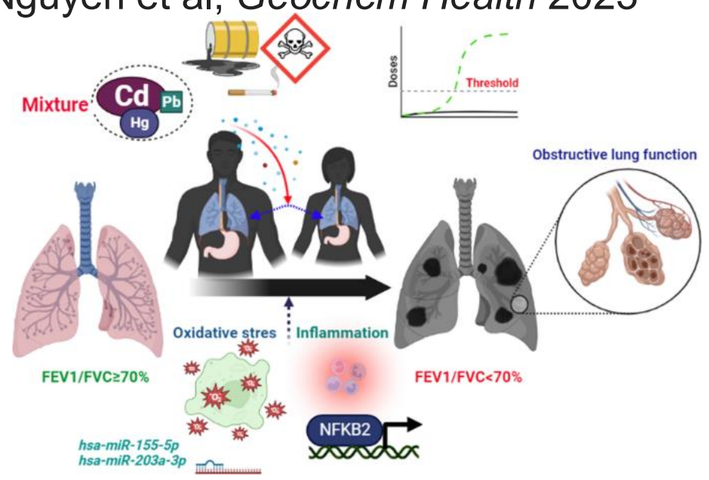
The ash samples were collected on November 7-8, 2023 from 100 properties in Lahaina, which had been constructed from the 1900s to the 2000s.

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

Industrial plantations: heavy metals/toxins

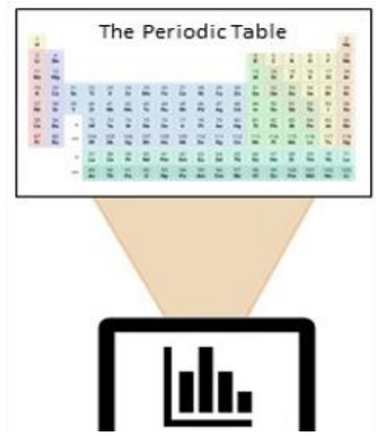
Mobilization of toxins due to fires

Nguyen et al, *Geochem Health* 2023



Mixtures of metal exposure on health

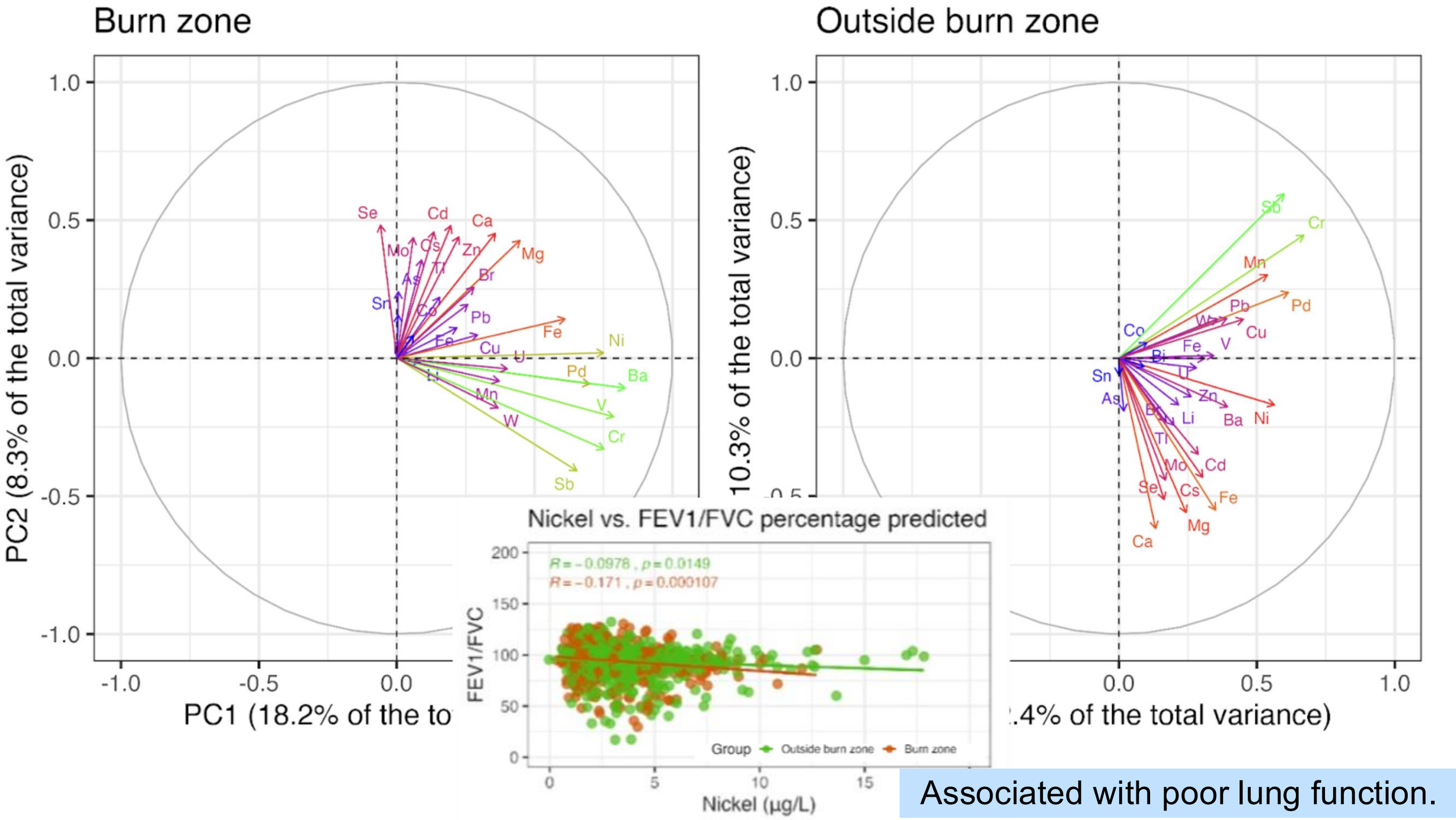
Urine Sample → Sample Processing → ICP-MS/MS Analysis → Data Integration



(Columbia Uni. Core)

(Re)-Exposures from Wildfire-Mobilized Heavy Metals

N=1,236; ~30 distinct elements from urine samples collected 6-12 months post-fires.



Associated with poor lung function.

- Burn-zone residents cluster on multi-metal axis (Sb, Ba, Cr, **Ni**, Pd) distinct from outside-zone.
- Higher levels associated with displacement, frequent ash re-exposure, and early recruitment period.
- Evidence for a wildfire-specific “metal fingerprint” and ongoing re-exposures up to 12 months later.

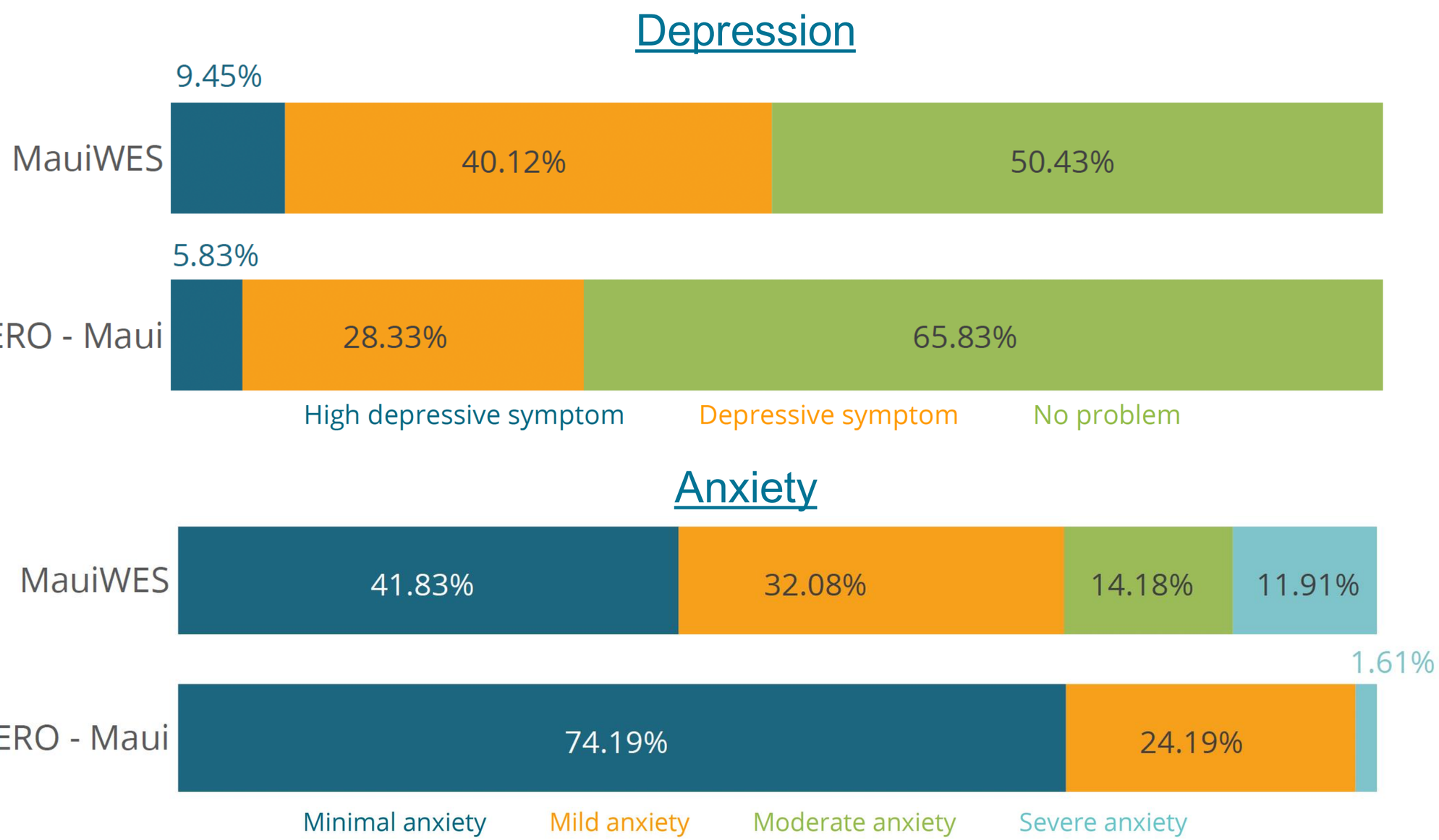
Main Take on Heavy Metals

- **Persistent exposure/re-exposure detected:** Toxic metals remain elevated (~20% of participants) 6–12 months after the fires.
- **Health risks are real:** Linked to respiratory issues (our data), and known to be associated with cardiovascular disease, neurological conditions, and cancer.
- **Action needed:** Long-term monitoring, cleanup, and survivor support.

Post-fire Declines in Mental Health: Adults

Alarming rates of mental health issues among adult survivors:

- 50% of participants showed depressive symptoms
- 26% had moderate to severe anxiety
- 4.2% had considered suicide in the past month



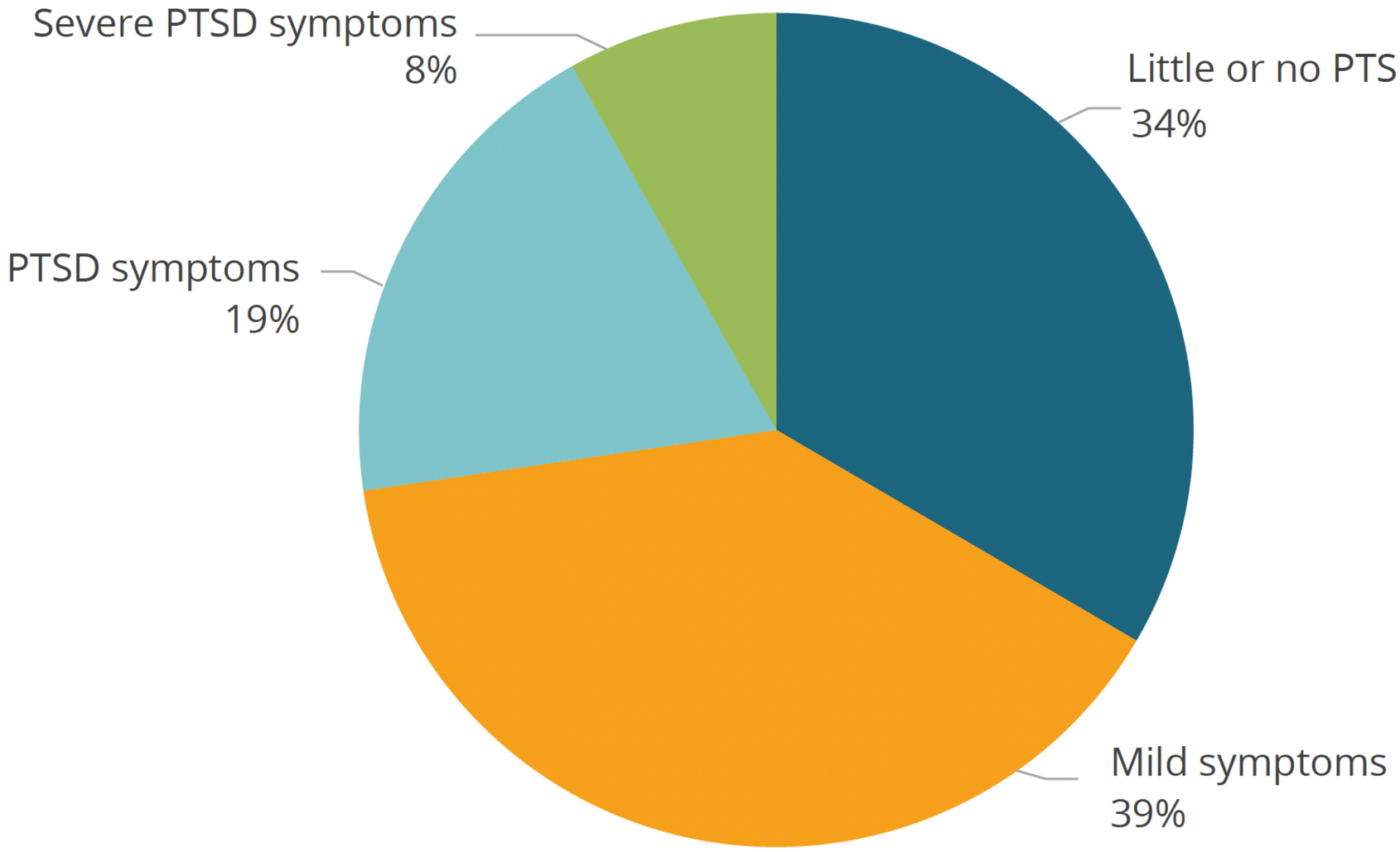
Many participants are showing improvements—moving from severe to milder levels of depression and anxiety—but overall distress remains high.

Post-fire Declines in Mental Health: Adults

High rates of PTSD among survivors:

- 39% mild symptoms
- 19% PTSD
- 8% Severe PTSD

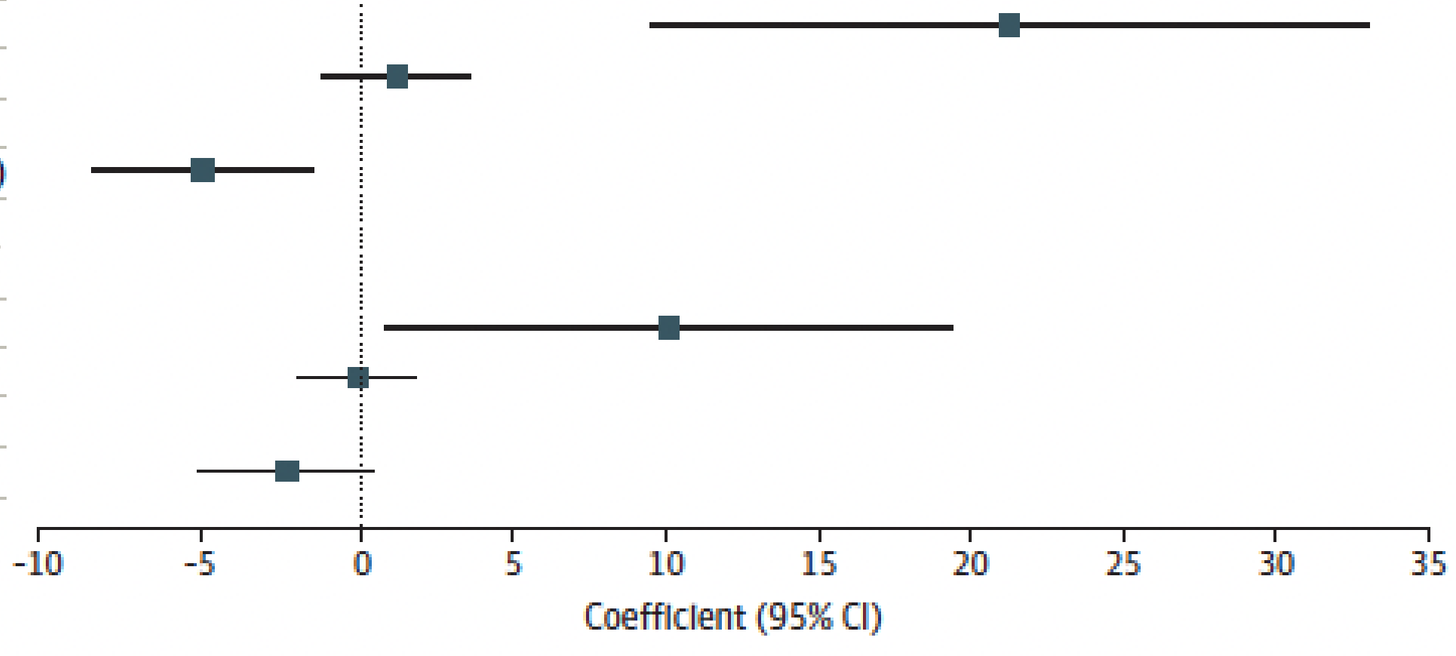
PTSD



From Crisis to Recovery: Health Impacts of the Maui Wildfires. University of Hawai‘i. https://uhero.hawaii.edu/maui-wildfire-health-report

Protective Effect of Social Support: Adults

Outcome by model term	Coefficient (95% CI)
Days affected by health issues	
Main effect of acute exposure	20.03 (8.87 to 31.18)
Main effect of social support (20-point increase)	0.93 (-1.39 to 3.25)
Interaction effect of acute exposure and social support (20-point increase)	-5.08 (-8.50 to -1.65)
Depression	
Main effect of acute exposure	9.43 (0.61 to 18.25)
Main effect of social support (20-point increase)	-0.27 (-2.10 to 1.56)
Interaction effect of acute exposure and social support (20-point increase)	-2.46 (-5.18 to 0.26)



- **Acute exposure** led to:

  ~20 more days affected by health issues.

  ~9-point increase in depression scores.

- **Interaction between acute exposure and social support**:

  Reduced the number of impacted ill by ~5—suggesting a *buffering effect*

  Modestly mitigated depression scores

Alarming Health Burden: Children

MauiWES

Screened Physical Health:

- ~40% had elevated or hypertensive blood pressure
- 18% had impaired lung capacity (FVC)
- 57% of children had normal exhalation (FEV_1); 31% mild-to-moderate obstruction; 13% severe airway obstruction

Mental Health

- 50% of children screened showed depressive symptoms
- 20% reported severe depressive symptoms
- 30% showed signs of anxiety disorder
- 15% experienced PTSD symptoms, with 4% severe PTSD

- Children often under-report distress

Impacts Beyond the Study

So far, we've reached over

2000

People affected by the 2023 Maui fires

825

Followed up with Healthcare Provider

760

Made lifestyle changes after receiving results

320

Accessed mental health services

Maui Health Registry

For those unable to join MauiWES, we lauched the MauiWES Health 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 (>6,000 affected)

MAUI-REGISTRY

Call to Action: Prioritize Health. Protect Our Future.

MauiWES

Help us Advocate for Long-Term Funding

- Most recovery funds have largely bypassed health and recovery
- Hazard Mitigation Plan must prioritize health with housing and infrastructure

Disseminate the Maui Health Registry

- Join us at MauiRegistry.org
- Looking for 6,000+ fire-affected individuals to be included in monitoring, referrals, and long-term care

Sustain and Expand MauiWES

- Largest post-disaster health study in Hawai‘i
- We are likely reducing capacity by October 2025 without renewed support
- Real-time data is saving lives—need to stay vigilant
- No other biomonitoring effort of exposures currently exists for residents

Fund School-Based, Culturally Rooted Mental Health Programs

- Trauma is rising—especially for youth and marginalized families
- Care must reflect culture, language, and trust

ʻIke Kūpuna

MauiWES

Pūʻali kalo i ka wai ʻole

…without water the kalo grows misshapen[+].

Not even taro—our life source—can thrive without water.
Our community cannot recover without sustained health resources, surveillance and healthy environment (land & water).

[+]Pukui, M. K. (compiled & translated). (1983). ʻŌlelo Noʻeau: Hawaiian proverbs & poetical sayings

Mahalo to Our Partners and Funders

Hawai'i Community Foundation
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MauiWES

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