CLIMATE ADAPTATION
RESEARCH SYMPOSIUM

MEASURING & REDUCING SOCIETAL IMPACTS

Housing and Hazards: How Should We Protect Vulnerable Homes?

Thanks for joining us!
The session will begin shortly.

UCLA Luskin Center for Innovation

Thank you to our event collaborators

SPONSOR

EDISON INTERNATIONAL®

PARTNERS

Atlantic Council

Adrienne Arsht-Rockefeller Foundation Resilience Center

American Society of Adaptation Professionals

Climate Resolve

EcoAdapt™

The Greenlining Institute

Island Press

LARC

Lincoln Institute of Land Policy

UC Davis Climate Adaptation Research Center

UCLA Center for Healthy Climate Solutions

Union of Concerned Scientists

CLIMATE ADAPTATION RESEARCH SYMPOSIUM

MEASURING & REDUCING SOCIETAL IMPACTS

Widgets are resizable and movable

You can drag the presenter's video around your screen.

Have a question for presenters? Click the ? icon.

C.J. Gabbe
Santa Clara University

Smitha Rao
The Ohio State University

Esther Sullivan
University of Colorado Denver

Zachary Lamb
UC Berkeley

CLIMATE ADAPTATION
RESEARCH SYMPOSIUM
MEASURING & REDUCING SOCIETAL IMPACTS

UCLA Luskin Center for Innovation

C.J. Gabbe

Associate Professor, Santa Clara University

@CJGabbe

Housing and Heat Vulnerability: Lessons from San José, California

Housing and Urban Heat: Assessing Risk Disparities in San José, CA

C.J. Gabbe, Evan Mallen, and Alexander Varni

UCLA Luskin Climate Adaptation Symposium | September 9, 2021

@CJGabbe

Santa Clara University

1. How do tree canopy, surface temperature, and air conditioning provision vary by housing type?

2. What disparities exist in overall urban heat risk by housing type and neighborhood characteristics?

What we know (and need to know)

- Communities of color and low-income communities are disproportionately exposed to heat (Hoffman et al., 2020; Wilson, 2020; Mitchell & Chakraborty, 2014)
- The built environment can influence biophysical risk of extreme heat (Jenerette et al., 2016; Mitchell & Chakraborty, 2015; Pearsall, 2017)
- Certain building characteristics, including AC access, can mediate vulnerability (Fraser et al., 2017; Gronlund & Berrocal, 2020; O'Neil et al., 2005; White-Newsome et al., 2012)
- Subsidized housing & manufactured housing are located at the intersection of heat and social vulnerability (Gabbe & Pierce, 2020; Pierce & Gabbe, 2021)
- **We know little about disparities in heat risk for residents of different housing types.**

Housing and heat risk measures

Parcel and tract characteristics	• SCC Assessor • City of San José • Census ACS (2015-2019)
Measure #1 | Exposure Lack of tree canopy	• City of San José tree inventory • Census block mean
Measure #2 | Exposure Higher temperatures	• NASA/USGS Landsat 8 for 8/9/20 • Census block mean
Measure #3 | Adaptive capacity No central air conditioning	• American Housing Survey (2017) • Predictive model for parcels

Component 1: Exposure	Component 2: Adaptive capacity
Share of block without tree canopy *Surface temperature*	*Probability of no central AC*

Heat Risk Index

- All input variables were standardized (Z-score) and the two components were equally weighted.

Linear regression models (parcel scale)

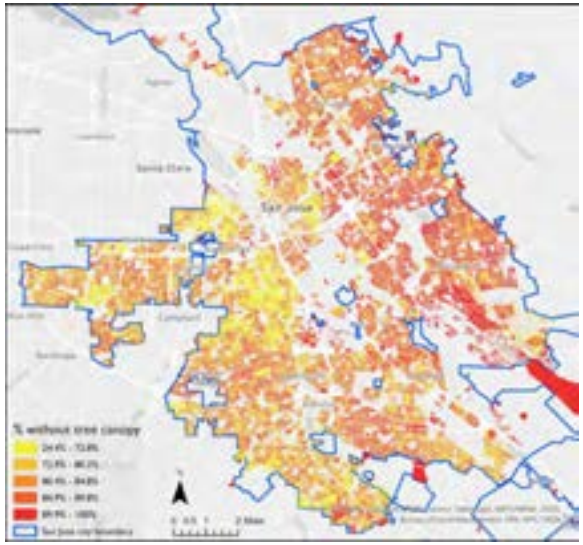
- **DVs:** (1) share of block without tree canopy, (2) surface temperature, (3) probability of no central AC, and (4) Heat Risk Index
- **IVs:** housing type (4 categories), population density, age, race/ethnicity, income, tenure, educational attainment

Heat risk = ƒ (parcel characteristics, tract characteristics)

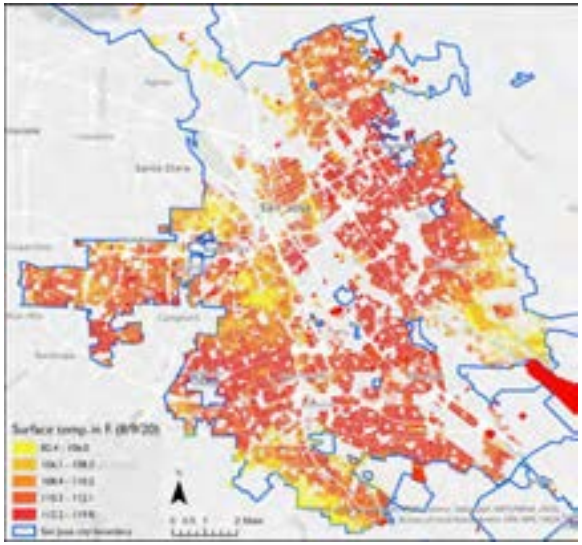
- Models include Zip Code fixed effects

Spatial distribution of residential heat risk

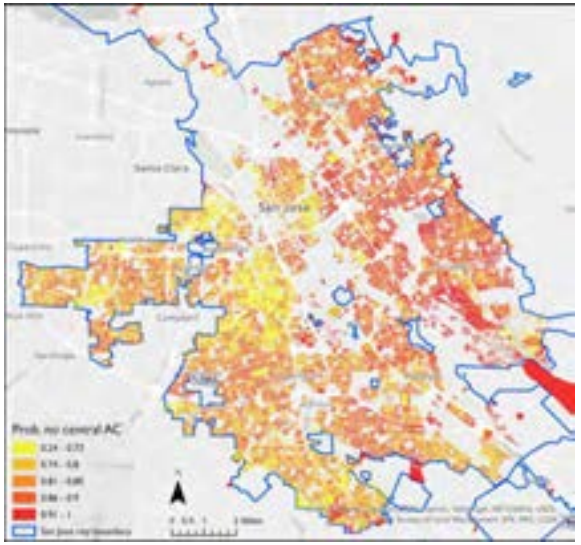
Exposure
Share of block without tree canopy



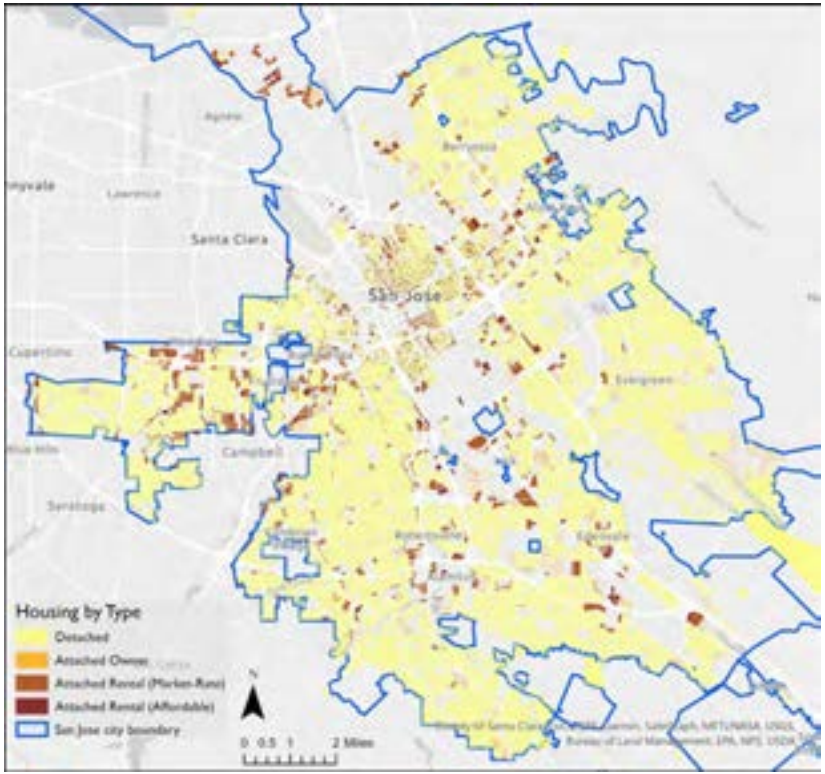
Exposure
Surface temperature



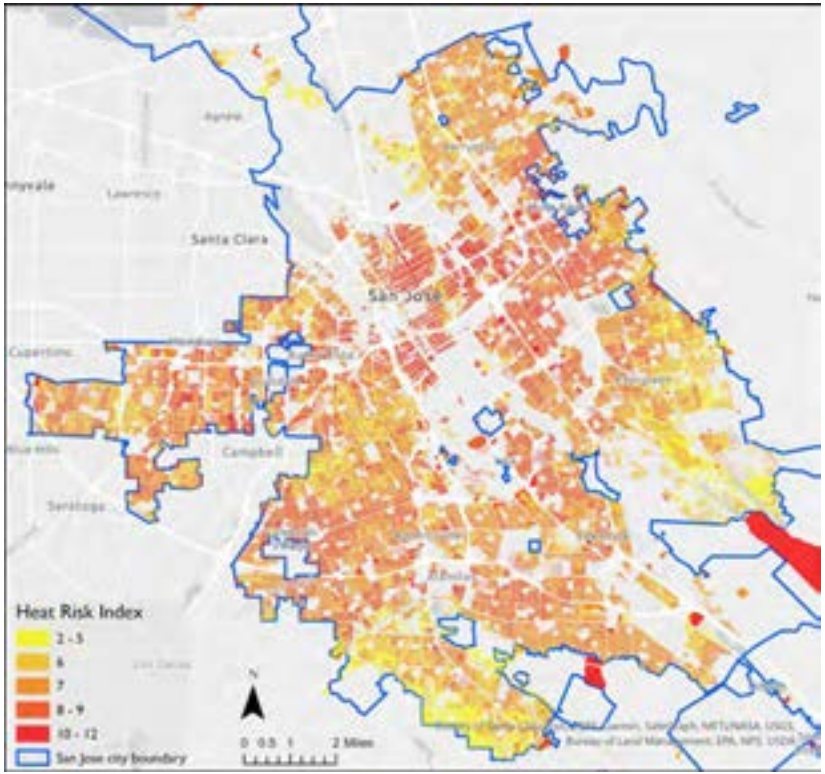
Adaptive Capacity
Probability of no central AC



Housing by type

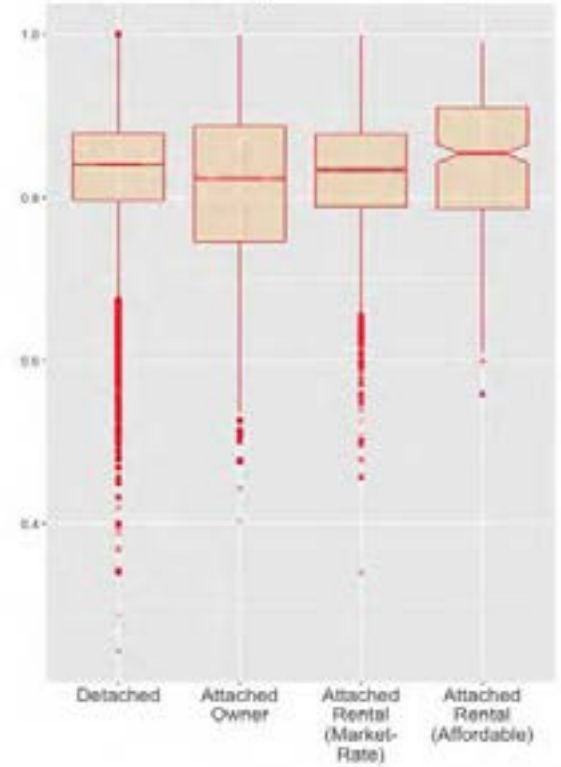


Heat Risk Index

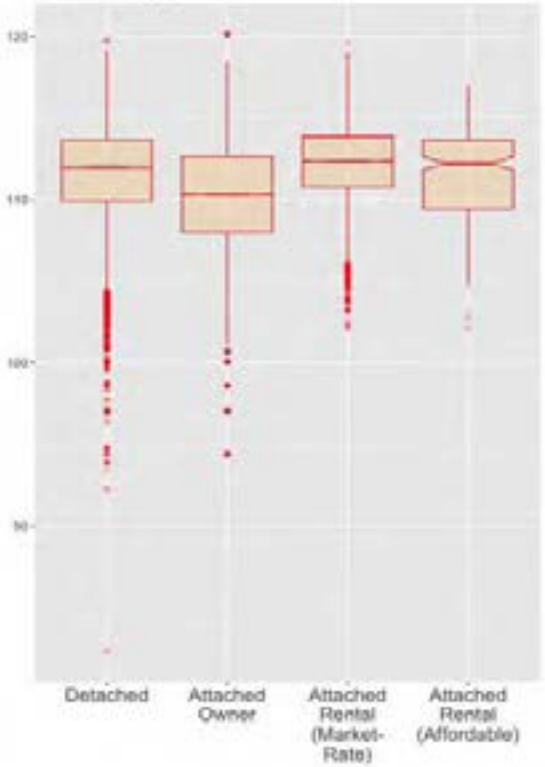


Heat risk measures by housing type

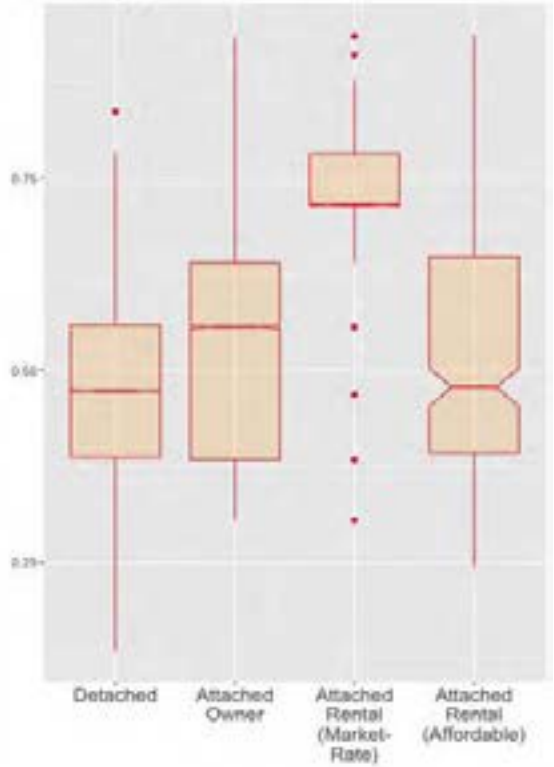
Exposure
Share of block without tree canopy



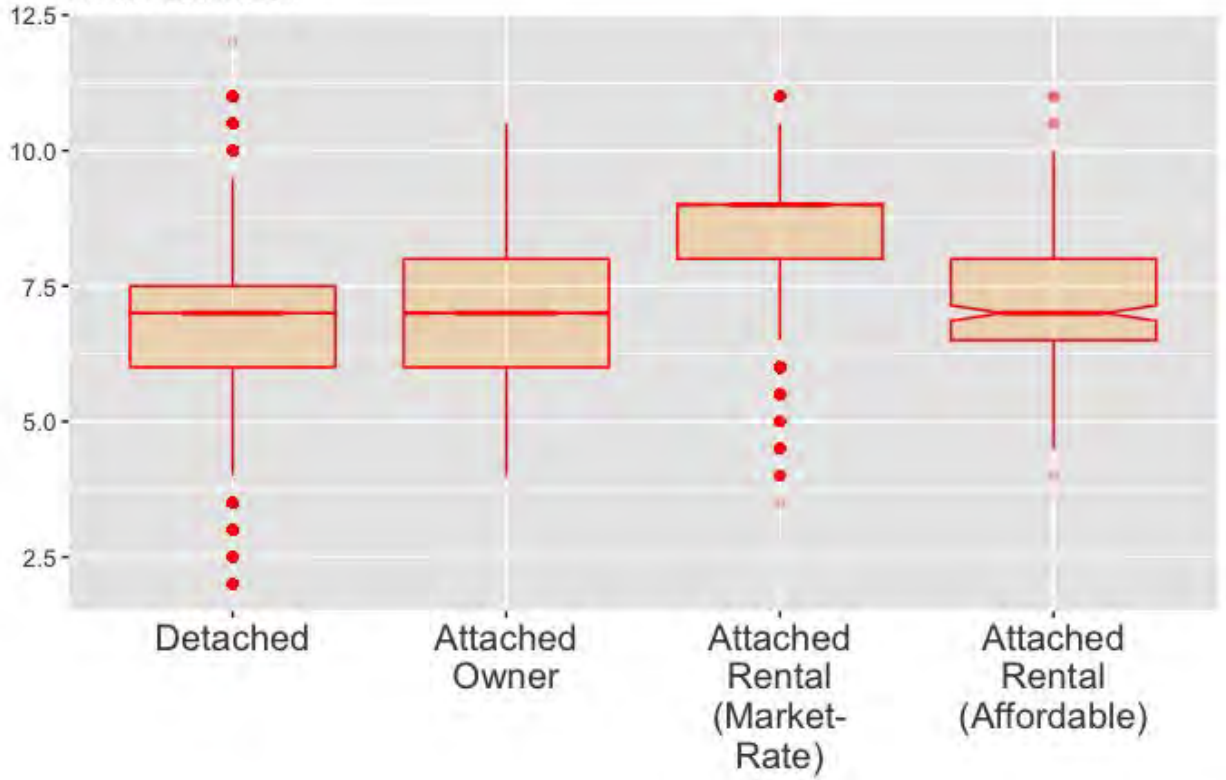
Exposure
Surface temperature



Adaptive Capacity
Probability of no central AC



Heat Risk Index by housing type



Regression results

	Share of block without tree canopy	Surface temperature	Probability of no central AC
Positive ***(more heat risk)***	***Attached rental**** % Hispanic % Asian	***Attached rental**** Population density % Hispanic % Asian	***Attached rental**** ***Attached owner**** Population density
Negative ***(less heat risk)***	***Attached owner**** Population density	***Attached owner**** % BA % renters	% Asian
Not significant	***Affordable**** Age & income % Black	***Affordable**** Age & income % Black	***Affordable**** Age & income % Black % Hispanic

*Relative to detached single-family units

Key findings

- Tree canopy and temperature vary by housing type, but the biggest difference is central AC availability.

- Households in rental multifamily generally face greater heat risk than those in other housing types.

- Affordable housing fares better than other rental multifamily because it is newer and more centrally located.

Policy implications

- Incentivize site-level interventions that reduce heat risk, particularly for low-income renters (e.g. shade, energy efficiency upgrades, cool roofs, AC subsidies, utility assistance).

- Focus neighborhood-scale investments (e.g. parks, urban forestry) in low-income neighborhoods and communities of color.

- Incorporate heat resilience into affordable housing programs.

Future research

- Additional outdoor temperature measures
- Indoor temperatures
- Other activity spaces (e.g. transit, schools, work)
- Intersection of heat, air pollution, and other hazards
- Provision and utilization of different AC types
- Housing developers' heat-related considerations

Thank you!

C.J. Gabbe, Evan Mallen, and Alexander Varni

UCLA Luskin Climate Adaptation Symposium | September 9, 2021

@CJGabbe

Santa Clara University

Smitha Rao

Assistant Professor, The Ohio State University

@smeedha

Social and Structural Vulnerabilities and Disaster Preparedness

Social & Structural Vulnerabilities and Disaster Preparedness

Smitha Rao (she/they)
MSc., MSW, Ph.D.
September 9, 2021
The Ohio State University

The Ohio State University occupies the ancestral and contemporary lands of the Shawnee, Potawatomi, Delaware, Miami, Peoria, Seneca, Wyandot, Ojibwe, and Cherokee peoples. The university resides on land ceded in the 1795 Treaty of Greeneville and the forced removal of tribal nations through the Indian Removal Act of 1830. I honor the people who have stewarded this land and acknowledge my role in working toward social, economic, and environmental justice.

Review of Scholarship

- Differential impacts of disasters
- Vulnerability affects disaster outcomes
- Socio-cognitive as well as external contextual (housing, neighborhood, policy) factors affect resilience to shocks
- Preparedness remains low

Elliott & Howell 2017; Kishore et al, 2018; Ritchie & Roser, 2019; Paton, 2003; Patterson et al, 2010; Comerio, 1997; Burby et al, 2003; Allen, 2006; DFID, 2011; Kuriakose et al, 2013

Disaster Preparedness

Pre-event preparatory actions

Evacuation plan; emergency kit; communication plan; food, water, medicines; financial and document preparedness

$1 invested saved $6 after disaster (FEMA)

Housing insecurity –affordability, safety, quality, instability, and loss of housing

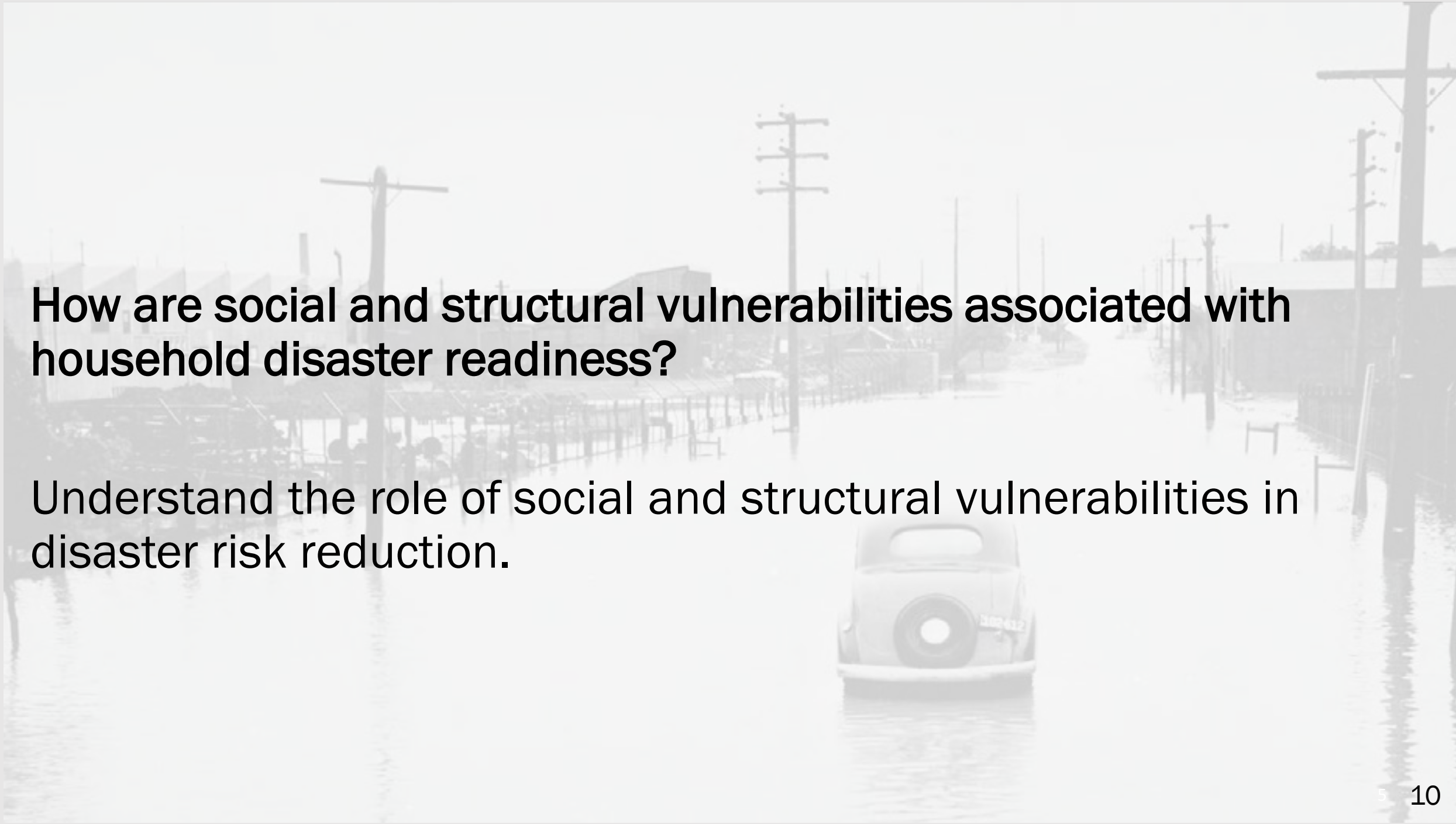
Social vulnerability associated with housing insecurity

- Living patterns are precursors to problems faced by disadvantaged populations

Renters less well prepared to survive in disasters

Living with housing insecurity heightens risk during community disasters

Burby et al, 2003; Metzker & Khare, 2017 ; Rivera & Miller, 2007; Sundareswaran et al., 2015, Kushel et al, 2006



How are social and structural vulnerabilities associated with household disaster readiness?

Understand the role of social and structural vulnerabilities in disaster risk reduction.

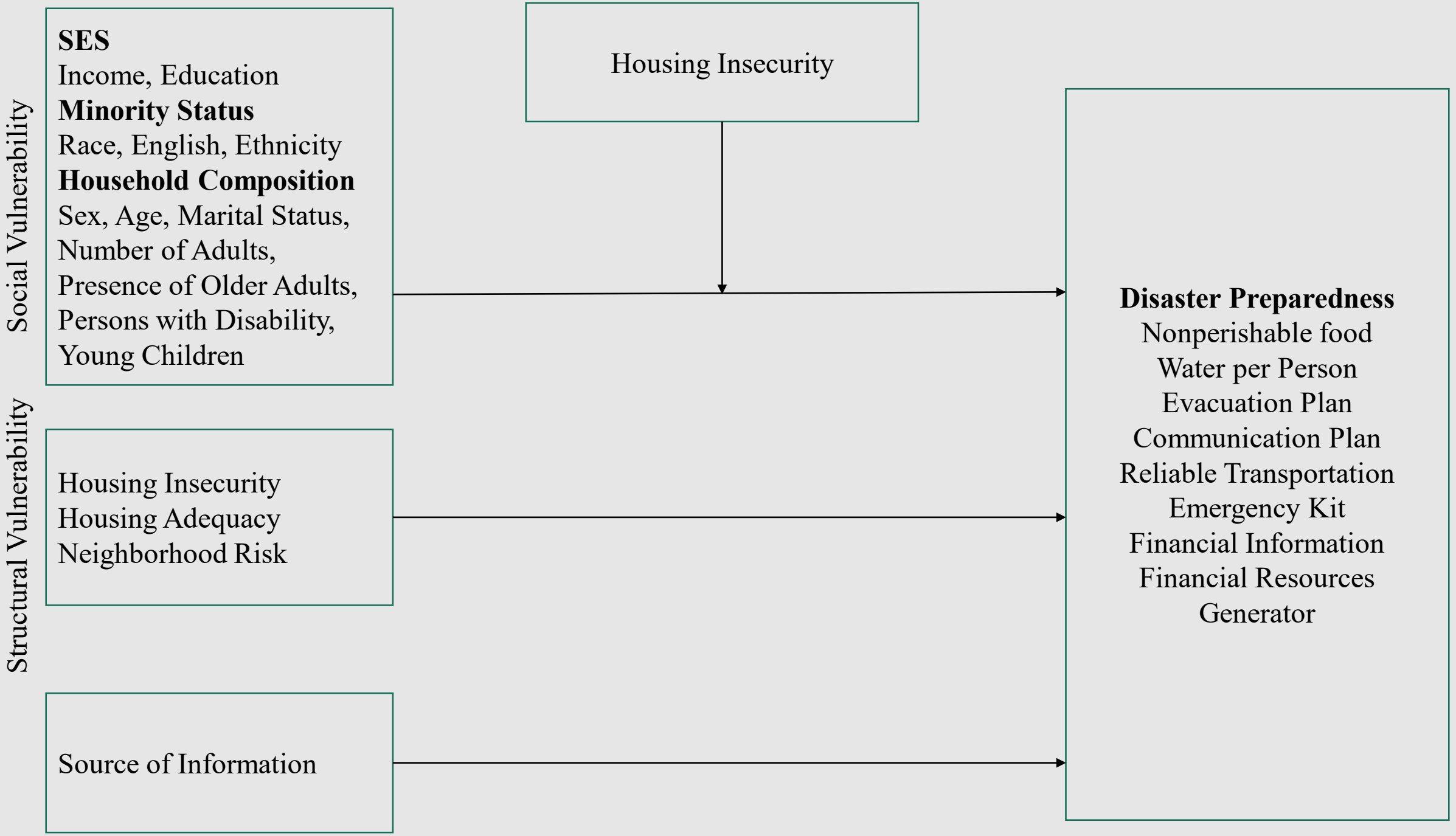
Capabilities and Vulnerability

Structural Vulnerability and Social Vulnerability

- Social: socioeconomic and demographic factors (SES, Race, Sex, Household demographics etc.)

- Structural: Multiple vulnerabilities that result in chronic situations including aspects of the built environment such as housing conditions and quality

Cutter et al., 2008; Flanagan et al., 2011; Lopez et al., 2018


Social Vulnerability
SES
Income, Education
Minority Status
Race, English, Ethnicity
Household Composition
Sex, Age, Marital Status,
Number of Adults,
Presence of Older Adults,
Persons with Disability,
Young Children
Housing Insecurity
Structural Vulnerability
Housing Insecurity
Housing Adequacy
Neighborhood Risk
Source of Information
Disaster Preparedness
Nonperishable food
Water per Person
Evacuation Plan
Communication Plan
Reliable Transportation
Emergency Kit
Financial Information
Financial Resources
Generator

Data and Sample

American Housing Surveys 2017, Public Use Files (PUF); Split sample weights

DV: Disaster Preparedness- 9 indicators

Cumulative preparedness- 0-9

Minimal Preparedness -0/1 (Food, water, funds, transportation)

IV- Structural Vulnerability: Housing Insecurity (Rental, Mortgage, Utilities related Delinquency); Housing Adequacy; Neighborhood Risk (Indicator variables)

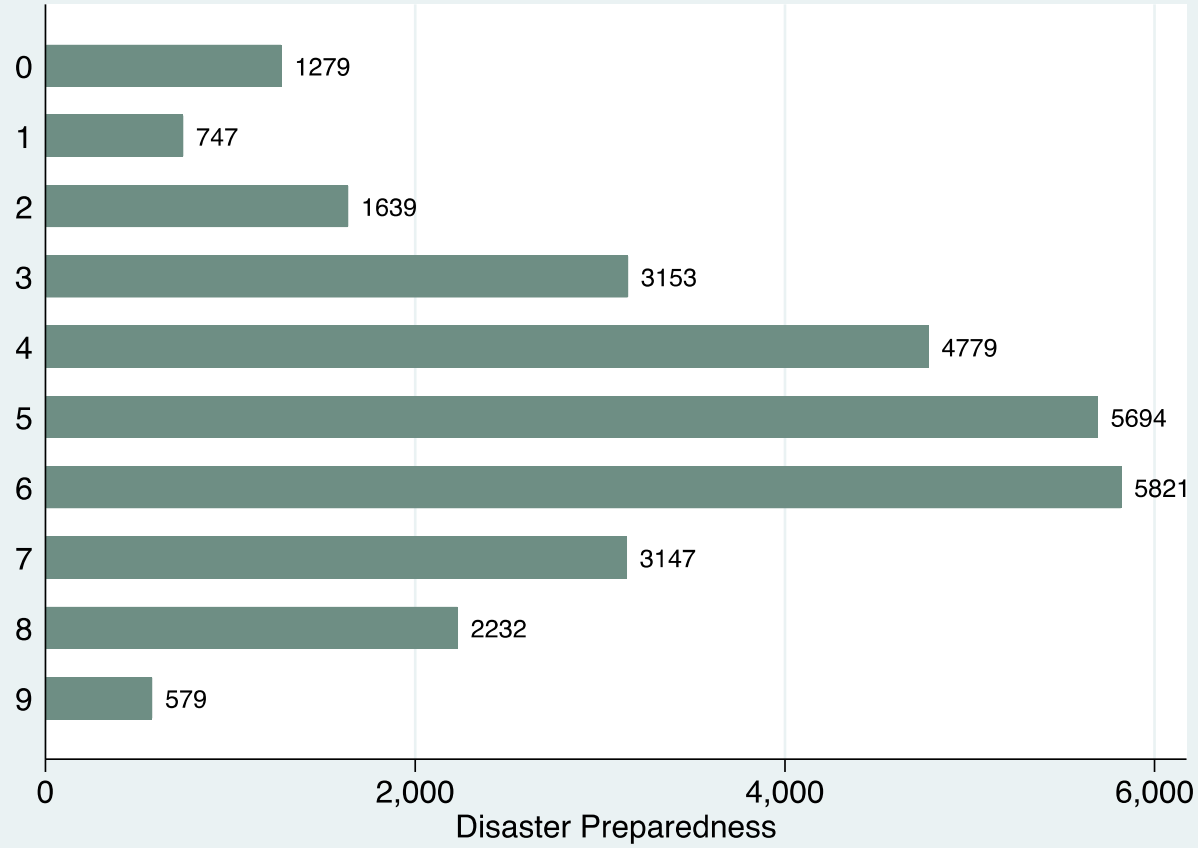
IV 2- Social Vulnerability: SES; Minority Status; Household composition

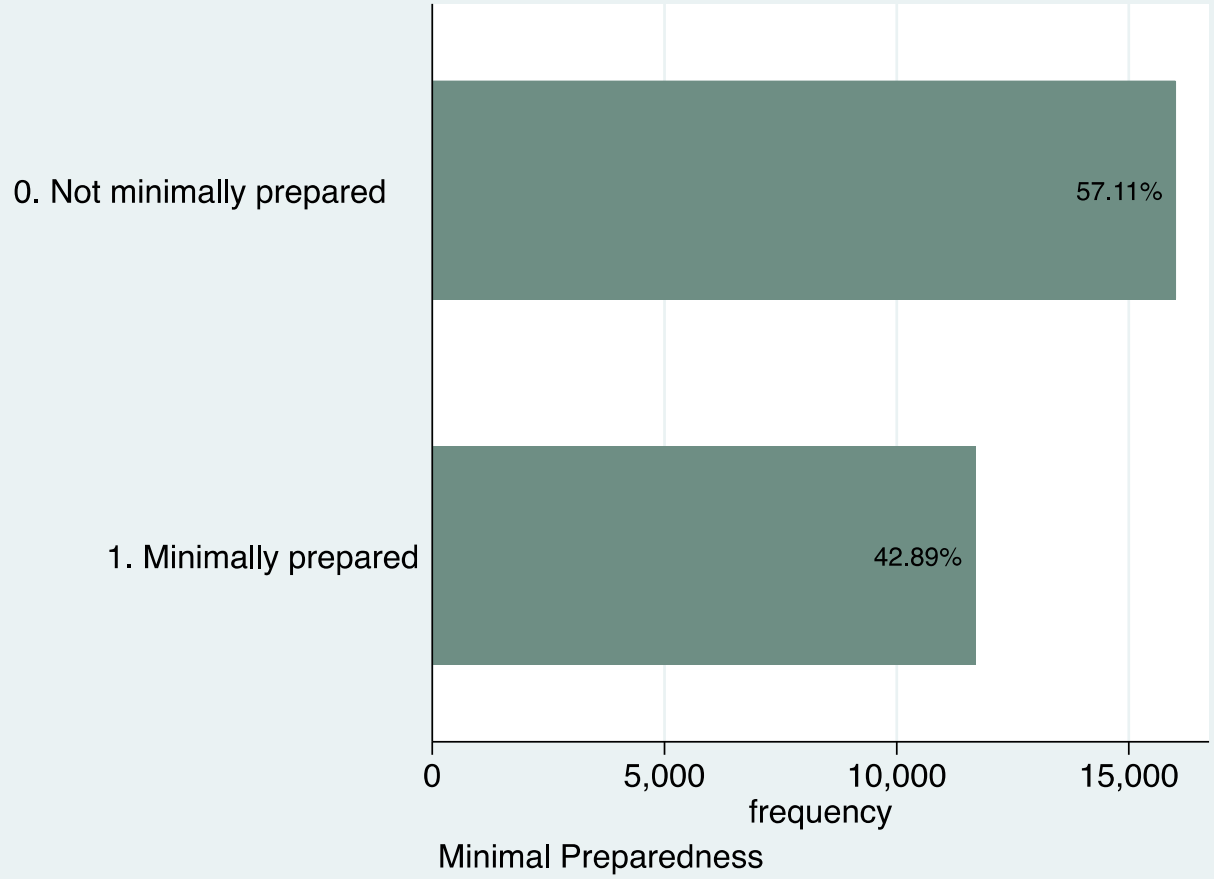
Interaction- Housing Insecurity and Social Vulnerability Factors

Stata version 16

Weighted Descriptive Statistics

N= 29,070





Weighted Descriptive Statistics

Variables	n	Freq	Percentage
Housing Adequacy	29,070		
Not Adequate		1419	4.98
Adequate		27651	95.02
Housing Insecurity	29,070		
No		24115	82.36
Yes		4955	17.64
Neighborhood risk perception	28,061		
No		25878	92.27
Yes		2183	7.73

Weighted Descriptive Statistics

SES

36% of sample earned less than 3000 USD;
40% of the sample had a high school degree and 12% has less than a high school degree

Race

White only- 78.39%
Black only—13.71%
Asian only- 4.85%
Alaskan Native/American Indian- 1.59%
Two or more races- 1.46%

Ethnicity

Latinx- 13.63%, non Latinx- 86.37%

Household Characteristics

51.74% Male
48.26% Female

49.53% Married
28.58% Widowed/Separated/Divorced
21.89% Never Married

28.82% units had older adults at home

22.79% units had persons with disability at home

11% of homes had children under 6

RQ1. How are social & structural vulnerabilities associated with disaster preparedness in the US?

Cumulative Preparedness	Coef.	Linearized SE	p-value	[95% Conf	Interval]
Housing Adequacy (Not Adequate)	0.000	.	.	.	.
1. Adequate	0.449	0.069	0.000	0.315	0.584
Housing Insecurity (No)	0.000	.	.	.	.
1. Yes	-0.177	0.039	0.000	-0.643	-0.349
Neighborhood Risk (No)	0.000	.	.	.	.
1. Yes	0.177	0.058	0.002	0.063	0.290

- Socio Economic Status positively associated with cumulative preparedness
- *Compared to male householders, women householders scored 0.13 units lower on the preparedness score*
- Race, marital status, presence of older adults associated with preparedness
- *Presence of person with disability at home associated with lower preparedness score.*

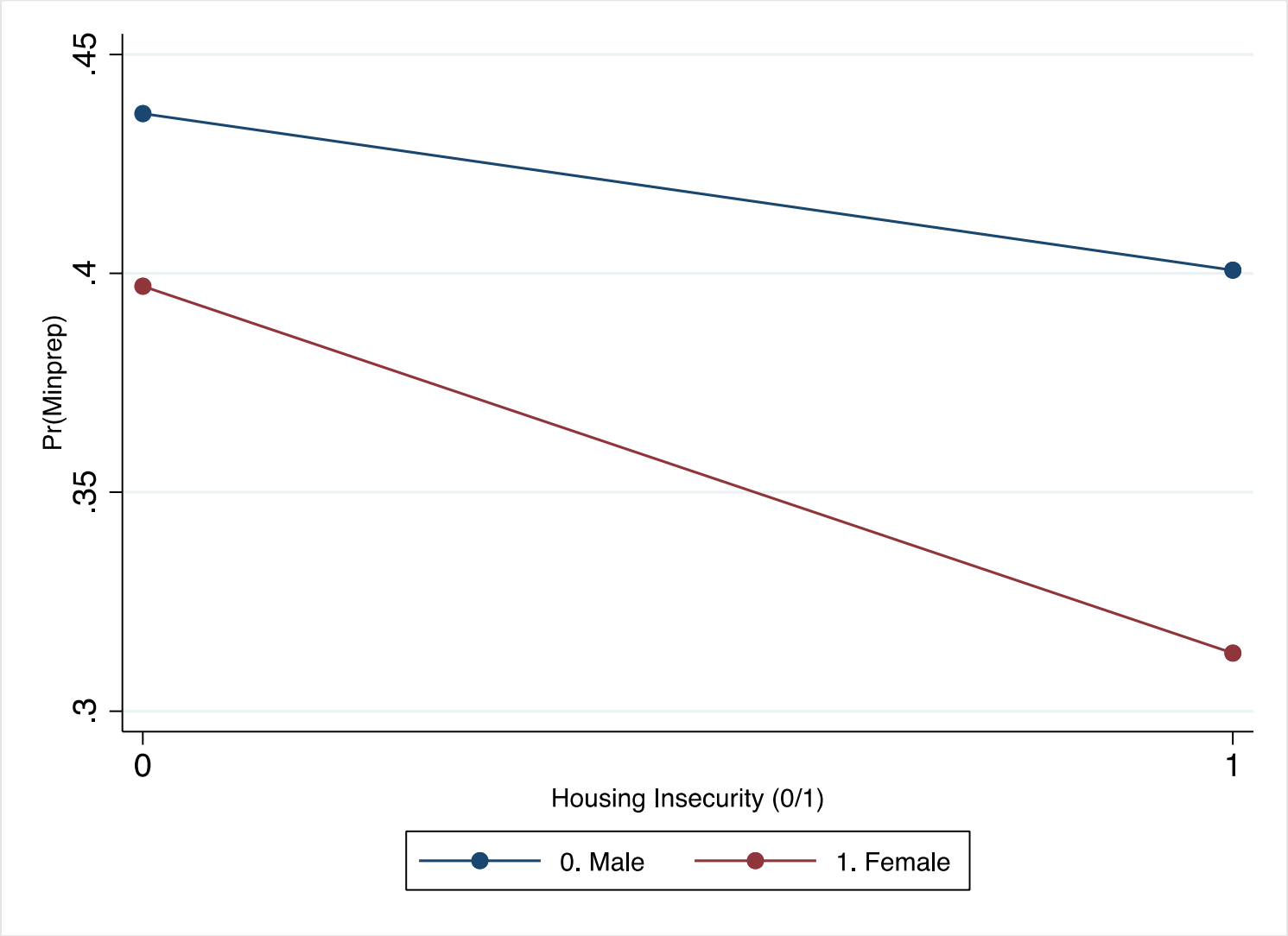
Minimal Preparedness	O.R.	[95% Conf Interval]	
Housing Adequacy (Not Adequate)	1.000	.	.
1. Adequate	1.89***	1.595	2.249
Housing Insecurity (No)	1.000	.	.
1. Yes	0.79***	0.720	0.863
Neighborhood Risk (No)	1.000	.	.
1. Yes	1.077	0.948	1.223
Race (White)	1.000	.	.
2. Black Only	0.85**	0.761	0.941
3. Asian/Pac.Islander/Am.Indian	1.04	1.42	1.853

Women householders had 17% lower odds of being prepared compared to their male counterparts (p<0.001, 95% CI [0.77, 0.89])

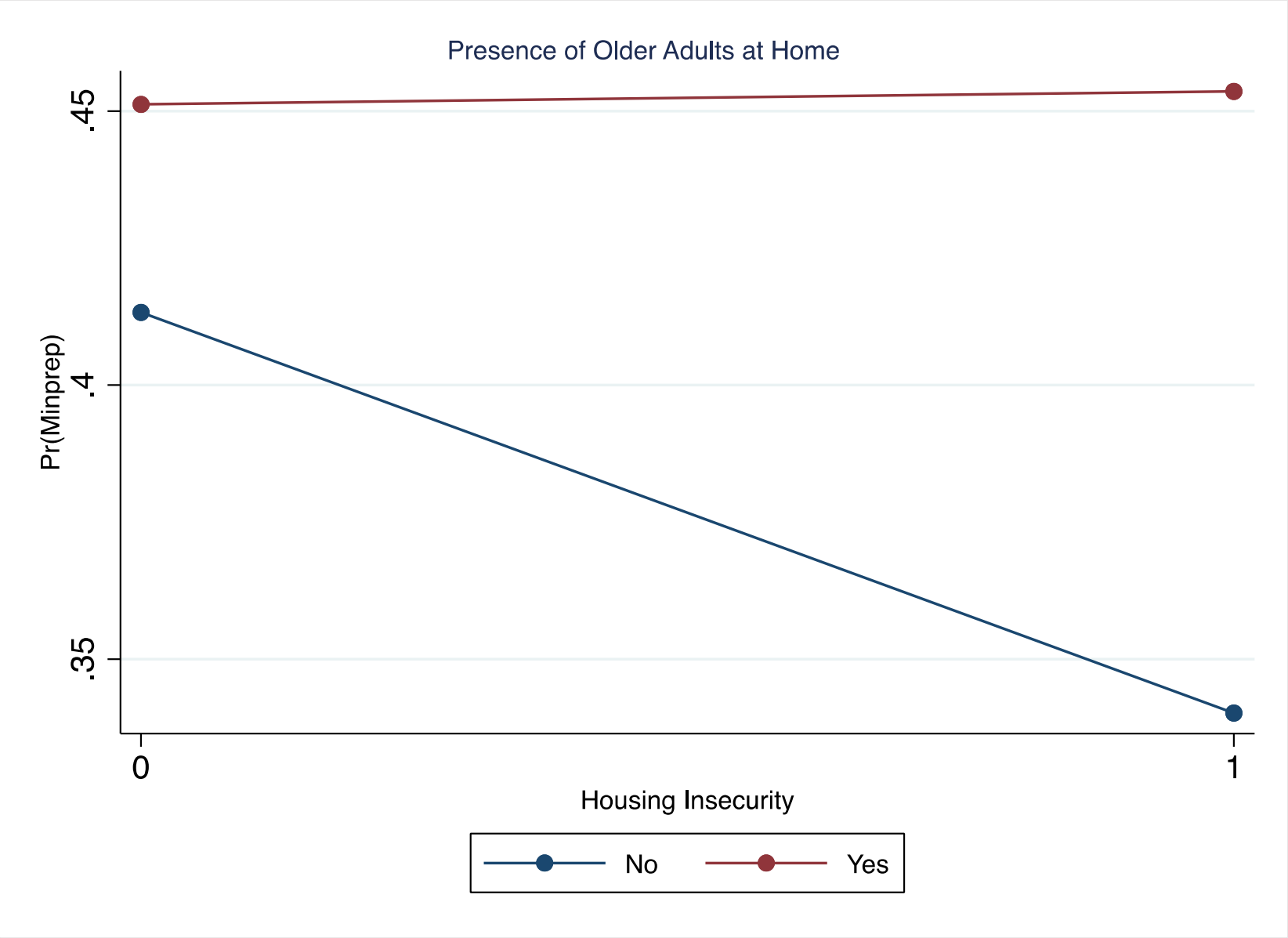
The presence of persons with disability at home was associated with 33% lower chances of being minimally prepared

Compared to getting information from friends and family, getting information from the internet was associated with lower odds of being minimally prepared by about 13% (p<0.001, 95%CI [0.78,0.96]).

RQ2. Does housing insecurity modify the effects of social vulnerability on disaster preparedness?



Housing Insecurity and Older Adults



Study Limitations

- Cross-sectional
- No established scale of preparedness
- Self reported data- response bias
- All disasters not equal
- Limitations of administrative data

Key Findings

Housing security and quality significant.

Women headed households less prepared.

Presence of older adults -higher preparedness.

Presence of persons with disability -lower preparedness.

Housing insecurity moderated association of SES, gender, presence of older adults

Implications

- Race and ethnicity inconsistently correlated with disaster readiness- need for within group analyses

- UN Sustainable Development Goals (Poverty Alleviation, Disaster Risk Reduction, Safe and Affordable Housing)

AHS- Disaster Preparedness

1 Does household have available non-perishable food for 3 days?

2 Does household have available at least 3 gallons or 24 bottles of water per person?

3 In some disasters, household members will need to evacuate separately. Does your household have an agreed-upon meeting point if that should happen?

4 Do the members of your household have a plan for communicating in the event that cell phone service is disrupted?

5 If you had to evacuate from your town or city to a safe place at least 50 miles away do you have enough reliable vehicles to carry all of your household members and a small amount of supplies such as clothes and food?

6 Does your household have emergency supplies readily available to take with you if you have to evacuate your home?

7 Would you have access to your vital financial information and contact numbers if you had to evacuate your home?

8 If you had to evacuate from your town or city to a safe place at least 50 miles away, do you have the financial resources, in terms of savings or available credit card balances, to meet expenses of up to $2,000?

9 Do you have a generator to provide electricity in case there is a power outage?

Esther Sullivan

Associate Professor of Sociology, University of Colorado Denver

Measuring the Impacts of Climate Change on Mobile Home Parks

Measuring the Impact of Climate Change on Mobile Home Parks: Evidence From Texas & Florida

TEXAS A&M UNIVERSITY
University of Colorado Denver
CU IN THE CITY

Andrew Rumbach | Esther Sullivan | Carrie Makarewicz
Seonju Jang | Shelley McMullen

Mobile Homes in the United States

17.5 million
people in the United States live in mobile homes, about 6.3% of occupied housing units

2.9 million mobile homes
are located in land-lease communities known as mobile home parks

31%
of households living in mobile home parks are in poverty, compared to 8.7% of owners and 15.4% of renters

3x
Mobile home parks are a substantial share of our affordable housing, providing three times the units as public housing (HUD 2016)

Mobile Home Parks & Climate Change

- In general, mobile home parks are understudied in the disaster and climate change literatures;
- Mobile home parks spatially concentrate socially vulnerable households;
- Mobile home parks are disproportionately exposed to extreme weather events like floods and wildfires;
- They are especially prevalent in the Sunbelt region, which is at high-risk from present and future climate change;
- Mobile home parks are poorly served by hazard mitigation and disaster recovery plans and policies.

How will future climate-related hazards impact mobile home parks in the United States?

Our Study Areas

Step 1: Inventorying Mobile Home Parks

- Identified addresses with tax record code indicating mobile home park
- Joined addresses with parcel-level boundary data
- Visually analyzed parcels using pre-disaster satellite imagery to count number of mobile home units


Tree Cover
Google Earth

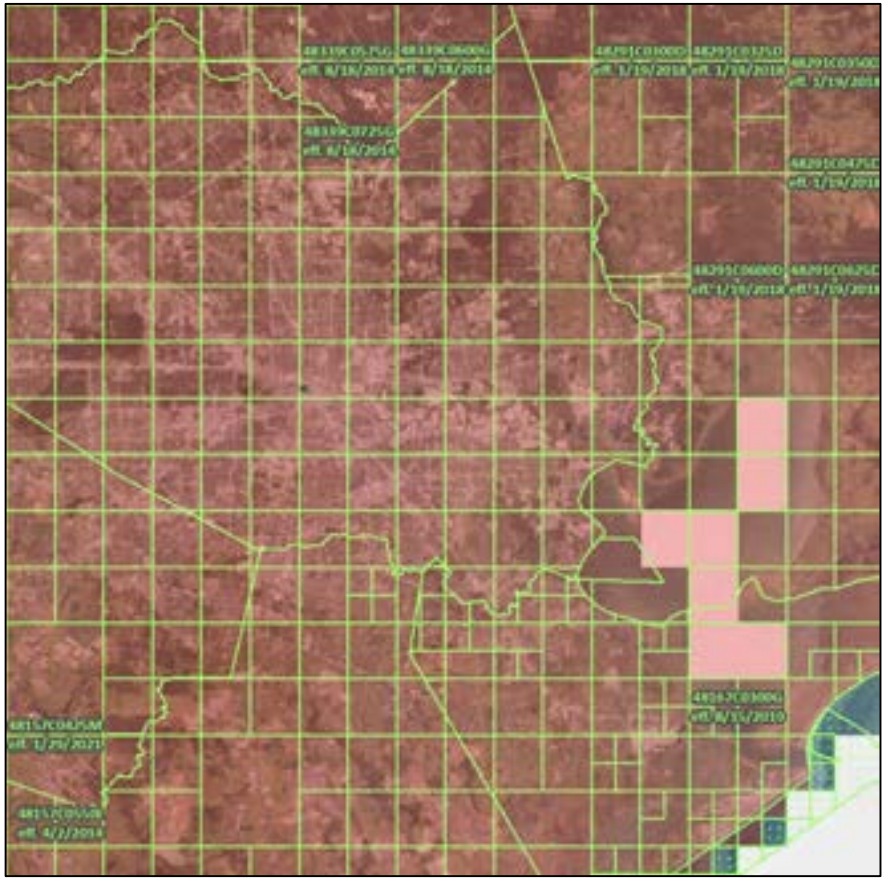

Overcrowding
Google Earth


Recreational Vehicles
Google Earth


Boundary Issues
Google Earth

Step 2: Overlay With Regulatory Floodplain Data

- Imported mobile home park inventories into GIS environment
- Overlaid with best-available regulatory (1% and .2% annual chance) floodplain data
- Parcel intersect method

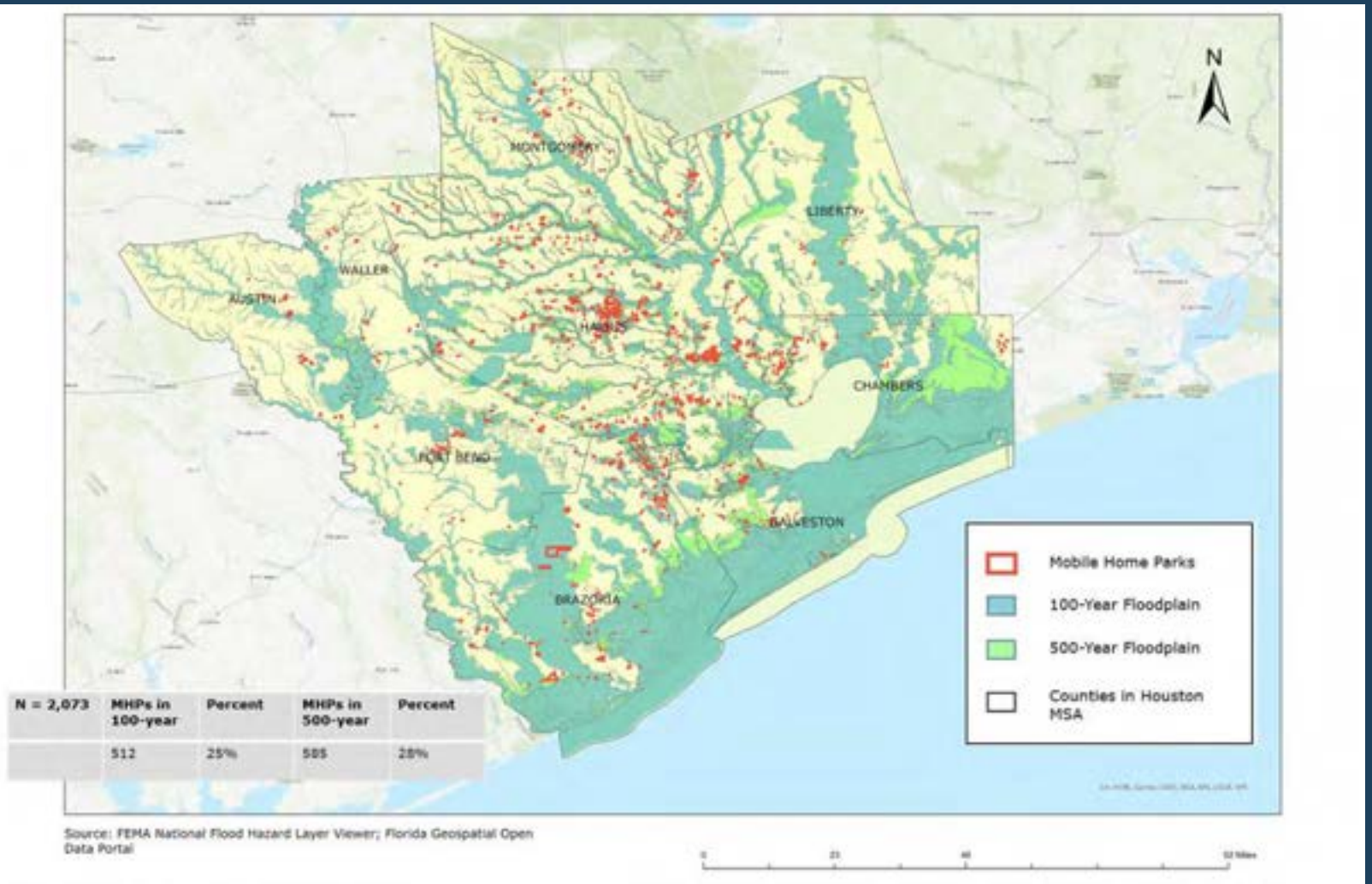


Step 3: Sea-Level Rise & Coastal Flooding

- Incorporate mid-range climate warming scenarios;
- Sea-level rise, coastal storm, and high-tide flooding;
- Ongoing…

N = 436	MHPs in 100-year	Percent	MHPs in 500-year	Percent
	135	31%	144	33%

Source: FEMA National Flood Hazard Layer Viewer; Florida Geospatial Open Data Portal



N = 2,073	MHPs in 100-year	Percent	MHPs in 500-year	Percent
	512	25%	585	28%

Source: FEMA National Flood Hazard Layer Viewer; Florida Geospatial Open Data Portal


Golden Meadow
131 E 177th St
Recently viewed
E 178th St
E 177th st
E 178th st

Adaptation Research & Policy Priorities

- Invest in state- and national-level data on mobile home parks;
- Model dynamics of exposure, vulnerability and recovery from extreme events to identify critically at-risk communities;
- Understand risk holistically – i.e. local government regulations are drivers of co-location and major impediment to relocation;
- Make mobile home parks ‘visible’ to federal and state mitigation + recovery programs;
- Develop state- and federal-level mobile home park legislation to guide local government action;
- Explore alternative ownership models.

Acknowledgements

This material is based upon work supported by the Natural Science Foundation under Grant No. 1825341

Thank You!

rumbach@tamu.edu | esther.sullivan@ucdenver.edu | carrie.makarewicz@ucdenver.edu

Zachary Lamb

Assistant Professor, UC Berkeley

@zacharylamb

Resident-Owned Resilience: Can Cooperative Land Ownership Enable Transformative Climate Adaptation for Manufactured Housing Communities?

RESIDENT-OWNED RESILIENCE

Cooperative Land Ownership and Transformative Climate Adaptation for Manufactured Housing Communities

UCLA Climate Adaptation Research Symposium
September 8-9, 2021

Zachary Lamb, UC Berkeley

CLIMATE TRANSFORMATION

"Can adapting to climate change… be a mechanisms for progressive and transformational change that shifts the balance of political or cultural power in society?"

(Pelling 2011)

CLIMATE TRANSFORMATION

"Can adapting to climate change… be a mechanisms for progressive and transformational change that shifts the balance of political or cultural power in society?"

(Pelling 2011)

'transformation depends on who has the power to act.'

(Romero-Lankao et al, 2018)

MANUFACTURED HOUSING COMMUNITIES

Largest source of unsubsidized affordable housing.

- 6,750,000 households in the US
- Compared to 4,500,000 in all federal rent subsidized units.

>50% urban and suburban locations.

Double burden

- Tenure insecurity and hazard vulnerability.

HAZARD VULNERABILITY

Exposure

Hazard prone siting of MHCs

(Gabbe et al 2020; Baker et al 2014)

Sensitivity

Physical

- House structure sensitivity

(Rumbach et al, 2020)

- Infrastructure sensitivity

(Pierce & Gonzalez 2017, Wallis 1997)

Social

- Income, elderly, disabled, education

(Cutter et al 2003, Tate et al 2021)

Adaptive Capacity

Economic precarity

(Desmond 2016)

Limited resident agency

(Sullivan 2014)

TENURE VULNERABILITY

'Halfway Homeownership'

Most MHC residents own home, not land.

(Sullivan 2018)

'Manufactured Insecurity'

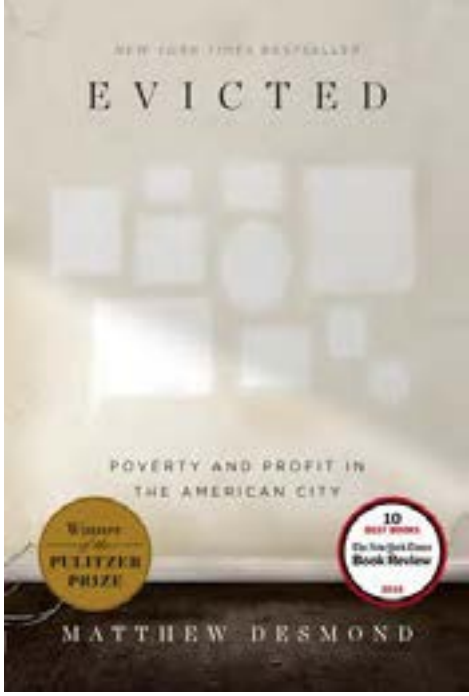
Little recourse against displacement, rent increases, etc.

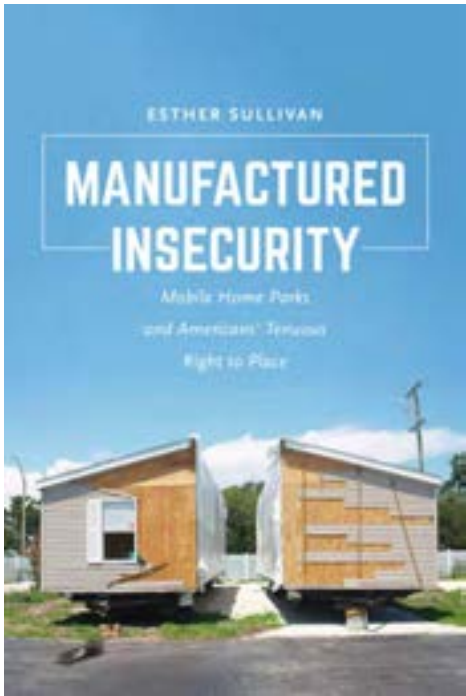
(Sullivan 2018, Desmond 2016, NCLF 2019)

Consolidation & Financialization

The 2 largest owners: REITs with nearly 200,000 sites.

(Petosa et al, 2020)





RESIDENT OWNED COMMUNITIES-USA (ROC-USA)

Model

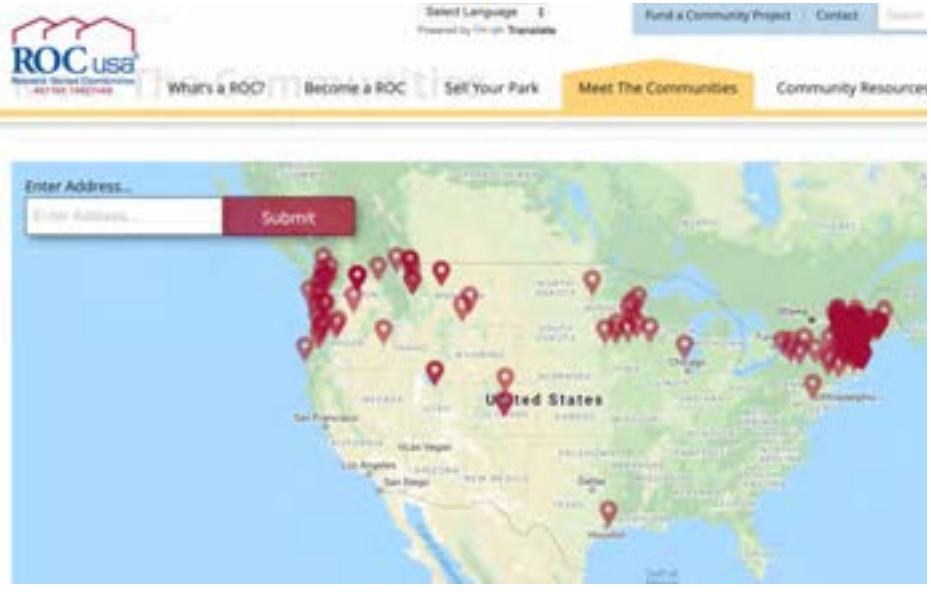
- Limited Equity Housing Cooperative (LEHC)
- Community ownership of land and infrastructure.
- Democratic self-governance.
- Low-cost loans, technical assistance, national network.

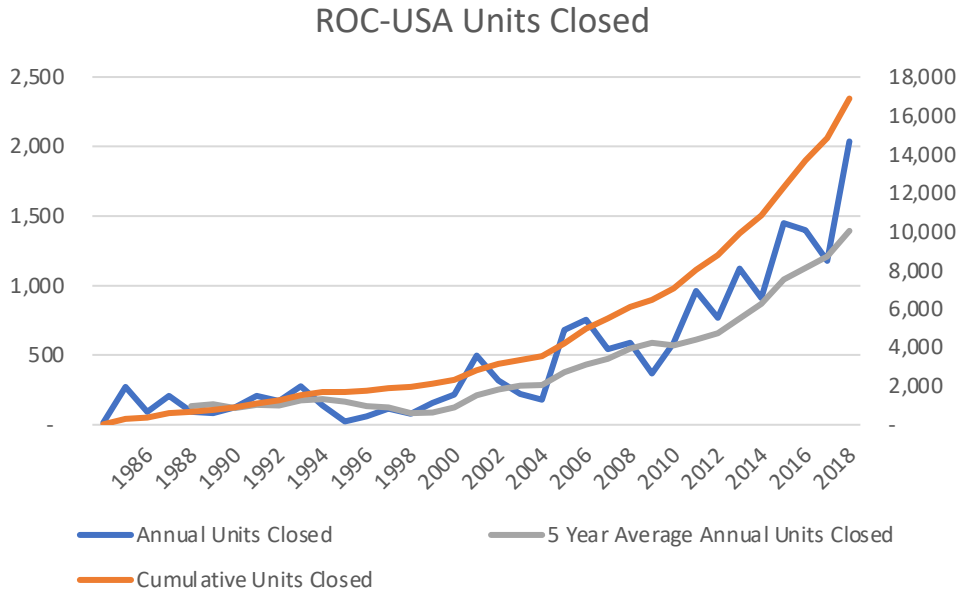
Rapid Growth

- >270 ROCs, 17,000 residents

Little Research

- None on vulnerability / adaptation.





RESEARCH QUESTION

How does the ROC USA model (of cooperative land ownership and self-governance) enable or inhibit adaptation to environmental stresses among residents in U.S. manufactured housing communities?

METHODS

GIS analysis of ROC and non-ROC MHC locations

Documents & procedures for co-op formation & governance

Interviews

- ROC-USA leaders and staff (n=3)
- TA Providers (n=18)
- Co-op leaders (n=9)

*No on-the-ground research to date due to COVID

FINDINGS

No significant differences between ROCs and other MHCs with respect to:

Elevated hazard EXPOSURE

Hazard-prone siting;

Heightened SENSITIVITY

Social

- Low income, immigrant, elderly, disabled.

Physical

- Housing units (pre-1976)
- Infrastructure failures

FINDINGS

ADAPTIVE CAPACITY

Co-op structure can both enable and inhibit adaptive capacity through:

- Mobilizable Resources
- Institutional & Social Capacity
- Information & Skills.

McEvoy et al (2019)

Mobilizable Resources

Limited access to conventional capital sources.

Low cost capital through ROC-USA (CDFI) and improved access to other public and private grants and loans.

Institutional & Social Capacity

−

Democratic self-governance can be hampered by internal division and conflict.

+

Tested management, training, and technical support model, including peer-to-peer support.

Information and Skills

External

- Ongoing technical assistance.

Internal

- Residents prioritize and address issues directly, drawing on their skills and experience.

- Due diligence includes resident infrastructure survey to find out “where the bodies are buried”

IMPLICATIONS OF THE ROC USA MODEL

Affordable Housing

Scalable / networked model for shared tenure & self-governance.

Extractive & precarious tenancy → Stability & self-determination.

Transformative Climate Action?

Joining experiential knowledge & agency for meso-scale adaptation (between municipal & household scales).

Semi-autonomous infrastructures could facilitate decarbonization & resilience for low-moderate income communities.

FUTURE RESEARCH

ROC USA

Collaborative national research agenda assessing how the ROC model shapes climate action and health equity.

California

Paired case studies of climate-impacted ROCs and conventional investor-owned MHCs.

GLADE: Governing Land for a Dynamic Earth

Research agenda on the planning and design implications of diverse property regimes in responding to climate change.

Thank You

zlamb@berkeley.edu

Up next – 10:15-11:45am PT

SESSION 6.1

Emerging Research on Financial Adaptations to Climate Impacts

SESSION 6.2

Wading into the Economic Impacts of Climate Change on Water

SESSION 6.3

Equitable Adaptation to Climate-Related Flood Risks: Part 2

CLIMATE ADAPTATION
RESEARCH SYMPOSIUM

MEASURING & REDUCING SOCIETAL IMPACTS

Thanks for tuning in!

UCLA Luskin Center for Innovation