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# Disabilities and Disasters: How Social Cognitive and Community Factors Influence Preparedness among People with Disabilities

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Community Health Sciences

by

Rachel Marie Adams

2018

ABSTRACT OF THE DISSERTATION

Disabilities and Disasters: How Social Cognitive and Community Factors Influence Preparedness among People with Disabilities

by

Rachel Marie Adams

Doctor of Philosophy in Public Health

University of California, Los Angeles, 2018

Professor Deborah Glik, Committee Chair

Disasters increase rates of population morbidity and mortality, especially among people living with disabilities. Engaging in pre-disaster preparedness behaviors, such as possessing an emergency supplies kit, having a disaster plan, and participating in community disaster planning, can help people protect against the negative health consequences of disasters. Despite their heightened vulnerability to the impact of disasters, studies suggest that people living with disabilities or other health limitations are less likely to participate in a range of disaster preparedness behaviors. Research examining the pathways that explain why people with disabilities are less prepared is lacking.

Based on a review of the literature, I hypothesize that people with disabilities have social psychological propensities, that I define as lower self-efficacy and response efficacy, both of which mediate the probability they will enact preparedness behaviors. I additionally hypothesize

that community-level factors, such as possessing lower neighborhood social capital and living in a community more socially vulnerable to disasters, intensifies the negative relationship between disability status and disaster preparedness. Conversely, living in a more advantaged neighborhood and one where residents are more exposed to risks, such as wildfires, reduces the negative relationship between disability and disaster preparedness.

To test these hypotheses, I utilized individual-level data from the 2013 Public Health Response to Emergent Threats Survey, a household survey conducted in 16 different communities in Los Angeles County, linked with community-level data from the Social Vulnerability Index (SVI) and the Healthy Places Index (HPI). Both the SVI and HPI are multi-component indexes that rank census tracts using publically available measures of community vulnerability and advantage, such as neighborhood, economic, and housing conditions.

Using these merged data sets, I conducted hierarchical linear regression analyses of a 10-item disaster preparedness behavior index regressed on four separate measures of disability status: self-rated health, presence of activity limitations, presence of a health problem requiring the use of special medical equipment, and considering yourself to be a person with a disability. I utilized Baron and Kenny's product method to conduct mediation analysis for both perceived self-efficacy and response efficacy. I additionally included measures of perceived neighborhood social capital, community social vulnerability, community advantage, and wildfire risk as interaction terms in multilevel regression models to test for moderating effects. Each of the models controlled for individual age, gender, and race/ethnicity, as well as accounted for the two-level structure of the data by including a random intercept for community.

The results from the multilevel models determined that in comparison to those with excellent self-rated health, those with good ($B=-0.4284$, $p=0.002$), fair ($B=-0.6936$ $p<0.001$), or

poor (B=-0.7660, p<0.001) self-rated health participated in fewer disaster preparedness behaviors, with a decreasing trend for lower ratings of health. The presence of activity limitations was additionally negatively associated with engaging in disaster preparedness behaviors (B=-0.2294, p=0.035). The results were non-significant for the two models whose main independent variables were the presence of a health problem requiring the use of special medical equipment and considering yourself a person with a disability, suggesting that these may be weaker measures of disability status. Although the results from the mediation analyses were mostly non-significant, it was determined that self-efficacy partially mediated the relationship between self-rated health and disaster preparedness (mediation coefficient=-0.1451, p<0.001). Finally, the moderation analyses established than neither perceived neighborhood social capital nor community social vulnerability were significant moderators of the focal relationship. However, living in a community that possesses a greater percentile ranking for advantage (B=0.0155, p=0.025) and one that has a higher proportion of the people at high risk for wildfires (B=0.0237, p=0.014) attenuated the negative relationship between poor self-rated health and disaster preparedness.

This dissertation addresses current gaps in the literature by elucidating the pathways that describe why people with disabilities are less prepared for disasters. Based on these findings, I recommend that preparedness programs and policy be twofold, both targeting self-efficacy as a more proximal precursor to engaging in preparedness behaviors as well as distal factors related to community advantage. Investing in programs and policies that invest in community housing and civic engagement can support preparedness behaviors, while bolstering overall health status linked to social and environmental determinants of health. Upstream place-based approaches can

decrease disaster health disparities and ultimately enhance resilience to disasters among people with disabilities.

The dissertation of Rachel Marie Adams is approved.

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Aimee Drolet Rossi

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2018

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**Adams, R. M.,** Karlin, B., Eisenman, D. P., Blakley, J., & Glik, D. (2017). Who participates in the Great ShakeOut? Why audience segmentation Is the future of disaster preparedness campaigns. *International Journal of Environmental Research and Public health*, *14*(11), 1407.

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**Adams, R. M.,** Prelip, M. L., Glik, D. C., Donatello, I., & Eisenman, D. P. (2017). Facilitating partnerships with community-and faith-based organizations for disaster preparedness and response: results of a national survey of public health departments. *Disaster Medicine and Public Health Preparedness*, 1-10.

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Chapter 1. Introduction

## Overview of Disasters

Natural and human-initiated disasters are escalating in scale and frequency.[1–3] Climate change, coupled with expanding development in vulnerable settings, contributes to the degradation of existing natural resources that protect against hazards.[4–6] Additionally, a growing number of people reside in at-risk areas, such as coastlines and flood-prone river basins.[6] Global urbanization and greater population density also increases the number of people exposed to potential hazards.[7] Of the ten most populous cities in the world, eight are at risk for major earthquakes and six are at risk for storm surges and tsunamis.[6] Densely populated urban areas are also disproportionally affected by human-initiated threats, such as acts of terrorism or disasters linked to technology.[8] Together these factors intensify the threat of disasters, leading to greater population health risks.

One of the main health threats associated with disasters is heightened mortality. In 2015, it was estimated that 32,550 people across the globe died due to a natural or technological disaster.[9] Trends in death rates are increasing, with major spikes over the last couple of decades resulting from three global "megadisasters," the 2004 Asian tsunami, the 2008 Cyclone Nargis, and the 2010 Haitian earthquake.[2] Mortality from disasters can result from both direct and indirect exposure to the event. Death from direct exposure results from the immediate physical forces of the disaster and the proximal causes of injury that vary with the nature of the event, such as experiencing falls, being crushed, drowning, or being poisoned.[7,10] Indirect mortality is caused by the unsafe or unhealthy conditions that ensue from the anticipation or occurrence of the disaster.[7,10] Loss or interruption of key services, such as health care and public utilities, are some of the secondary outcomes that contribute to indirect mortality.[7,10] Due to the varying time

of death relative to the disaster, indirect causes can go underreported, which contributes to an overall underestimation of disaster-attributed deaths.[2,7]

Disasters also contribute to substantial population morbidity. The types of health conditions and injuries that arise generally vary according to the specific type of disaster, as well as the environment and population that is affected.[7] For example, the presence of acute respiratory symptoms caused by poor air quality is unlikely to occur during an ice storm, but is a condition that often results from wildfires and volcanic eruptions. Across all hazards, trauma-related stress contributes to mental health conditions.[11] Post-traumatic stress disorder, as well as major depression, anxiety, and panic disorders have all been studied in the context of disasters.[12] Physical injuries and exacerbation of existing health conditions are other common examples of all-hazard health outcomes. Again, these can arise from both direct and indirect exposure to a disaster, contributing to diverse and far-reaching health consequences.[7]

**Vulnerable Populations to Disasters**

To recognize who is vulnerable to disasters, we must first understand what is meant by vulnerability. While there are several conceptualizations of disaster vulnerability, it has historically been conceptualized as a function of physical exposure to hazards.[7,13] Exposure to hazardous environmental conditions, such as proximity to fault lines and flood plains, is an important aspect of vulnerability; however, we must additionally account for the demographic and socioeconomic factors that can influence a population's potential for loss. More recently, social science researchers have assumed a social vulnerability perspective.[7,13] Social vulnerability is both a measure of how social groups are susceptible to disaster harm and their ability to respond to and bounce back from a disaster.[13] It also encompasses inequities in place, which includes socioeconomic characteristics of communities, as well as the built environment,

such as the economic and housing conditions.[13] Different components that make up this construct include lack of access to resources, limited access to political power and representation, physical limitations, limited social capital, high density of living, and inadequate infrastructure.[13,14] Vulnerability is thus a function of how these various social factors interact with a hazard's specific characteristics, both in terms of potential exposure and the ability to cope by accessing available resources.[15,16] Closely related to vulnerability is the concept of community resilience, a community' sustained ability to recover from disasters. Resilience is also shaped by the inherent characteristics and conditions of a social structure that allow people to cope with and absorb the impact of a disaster, as well as re-organize, change, and learn in response to a threat.[17] Research that examines the multi-dimensional social factors that contribute to disaster vulnerability and resilience can lead to more targeted planning and preparedness.[18,19]

Research has identified certain groups of people who are at greater risk of the health consequences of disasters. Among the well-researched vulnerable populations are the elderly, children, single parent families, low socioeconomic status groups, non-dominant language speakers, marginalized racial/ethnic groups, medically dependent populations, and people living with disabilities.[5,18,20] These social groups are more vulnerable to the different stages of a disaster, from evacuation compliance to long-term recovery.[19–21] Belonging to these vulnerable social categories also often occur in combination, leading to compounding susceptibility to the impact of disasters.[19]

Among those most vulnerable to disasters are people living with one or more disabilities. Disability, according to the World Health Organization's International Classification of Functioning, Disability and Health, serves as an umbrella term for impairments, activity limitations, or restrictions in the involvement of life situations.[22] People living with disabilities

are thus members of the population who experience health conditions that interfere with functioning. This broad but meaningful conceptualization includes people who experience physical, mental or emotional limitations and is meant to be used for decision-making purposes,[22] including applications of disaster research.

Globally, it is estimated that 15% of all people live with some form of disability, 2-4% of whom experience significant difficulties in daily functioning.[23] In the United States (U.S.), the prevalence of people living with disability is even higher, which may be a reflection of greater focus on different impairment questions in population health surveys.[23] According to the most recent U.S. Census, almost one in five Americans live with some type of disability, as measured by the level of difficulty of performing a specific set of functional and participatory activities.[24] Of these 56.7 million people, more than half consider themselves to have a severe disability and over a quarter have difficulties with one or more instrumental activities of daily living, such as doing housework or preparing meals.[24]

People living with disabilities are at greater risk for the negative consequences of disasters, as the built infrastructure and emergency procedures are generally designed for people without disabilities.[25] Furthermore, overlapping demographic and social factors, such as poor living conditions, higher poverty rates, undiversified sources of income, lower employment rates, societal stigmatization, and secondary health conditions, place people with disabilities at greater risk during a disaster.[26,27] Accounts from recent disastrous events exemplify the vulnerabilities and lack of planning for these individuals. During Hurricane Harvey, which affected the Texas Gulf Coast in 2017, there were several stories documenting how people with disabilities were trapped inside their homes as the greater Houston area began to flood.[28] Many of the victims who were killed by the 2017 wildfires in Northern California were frail and elderly or possessed other

physical disabilities.[29] In the aftermath of Hurricane Irma, which ravaged parts of South and Western Florida, power outages led to exacerbated health conditions and deaths among nursing home residents.[30] These recent events, as well as a growing body of research, highlight how people with disabilities can experience greater difficulties before, during and after a disaster.

**Preparing for Disasters**

Citizens and communities play a crucial role in planning for disasters. Nationally, the Federal Emergency Management Agency (FEMA) recommends a specific set of behaviors for an all-hazards approach to disaster preparedness. FEMA advises that each household develop emergency plans, possess a disaster supplies kit, and stay informed about local disasters.[31] More recently, FEMA also recommends that individuals get involved in community disaster planning in order to build a community's capacity to respond to and recover from disasters.[32] Household preparedness, such as having extra supplies of food and water, helps ensure that people can care for themselves and their families during the first 72 hours following a disaster. Engaging in community planning, such as participating in first aid trainings and attending community meetings where evacuation plans are discussed, can additionally improve the speed and effectiveness of relief and recovery efforts by increasing support for emergency response agencies.[4] Vulnerable groups, including people living with disabilities, can therefore reduce their susceptibility to the negative consequences of disasters by engaging in preparedness behaviors.

Despite being at greater risk for harm, studies suggest that people with disabilities, health limitations, or worse perceived health are less prepared for disasters than the general population.[33–37] These findings exist across a range of preparedness behaviors, including possessing different emergency supplies, developing evacuation plans, and participating in CPR or first aid trainings. [33–37] Nevertheless, studies examining why this population is less prepared or

how to better target their preparedness behaviors are currently lacking. To be able to target them for preparedness promotion programs and ultimately influence their behavior, research is needed to specify the pathways that explain why people with disabilities are less prepared.

In addition to gaps in the literature, recent policy documents emphasize the need to include and prioritize people with disabilities in disaster planning efforts.[38–40] Among these documents is the United Nations' Sendai Framework for Disaster Risk Reduction, an international agreement that provides a set of targets, priorities, and guiding principles to help government agencies and other stakeholders prevent and reduce disaster risk.[40] The Sendai Framework contains explicit recommendations toward disability-inclusive disaster risk reduction. First, it states that governments need to create a more people-centered preventive approach to disaster risk by including relevant stakeholders, such as people with disabilities, in the design and implementation of policies, plans and standards.[40] Second, the framework asks that risk reduction practices be more accessible, alluding to the need to develop plans to enhance accessibility in education, transportation, housing, and employment settings.[26] Third, one of the priorities for actions states that ''empowering women and persons with disabilities to publicly lead and promote gender equitable and universally accessible response, recovery, rehabilitation and reconstruction approaches are key."[40] Finally, it describes persons with disabilities and their organizations as critical stakeholders in designing and implementing disaster plans, which promotes partnerships with disability groups and advocates.[40]

Although the Sendai Framework emphasizes the importance of including people with disabilities in disaster planning efforts, it merely provides a set of priorities and guiding principles and is not a toolbox for specific practices. In fact, the framework even calls for the need to incorporate disaggregated data by disability status in order to inform inclusive planning

procedures.[40] Disaster preparedness research that specifically focuses on people with disabilities has been lacking, highlighting the need for additional research to identify the preparedness needs and barriers among people living with disabilities. This dissertation thus aims to examine 1) how having disabilities influences disaster preparedness behaviors in comparison to the general population, 2) what social cognitive factors explain existing preparedness discrepancies, and 3) how these behaviors vary with community attributes. To accomplish these aims, I analyzed data from the 2013 Public Health Response to Emergent Threats Survey, a household survey conducted in 16 communities in Los Angeles County, and two publically available community-level indexes, the Social Vulnerability Index and the Healthy Places Index. More specifically, I used these data sources to examine and test the pathways that link my two focal variables, disability and disaster preparedness. Los Angeles County, the dissertation setting, is threatened by a number of natural disasters, including earthquakes, wildfires, mudslides, and tsunamis, as well as human-initiated threats such as technological hazards and acts of terrorism. It is also a region with large social and economic disparities, making it a valuable setting to study how community-level attributes influence individual disaster preparedness behaviors among vulnerable members of the population. Results from this dissertation with will help elucidate the pathways and factors that influence disaster preparedness behaviors among people with disabilities and can thus be used to guide more inclusive and targeted disaster risk reduction strategies.

Chapter 2. Empirical Literature Review

To inform my specific research questions and hypotheses concerning the relationship between disabilities and disaster preparedness, I conducted a review of the empirical literature. I first reviewed studies that focus on how people with disabilities are vulnerable to different aspects of disasters. I then examined what is currently known about disaster preparedness behaviors in the U.S. and in Southern California, my study setting. Next, I reviewed research on preparedness behaviors across different socio-demographic groups, including people with disabilities. Additionally, I examined the different social cognitive and environmental factors that are associated with preparing for disasters. Finally, I assessed how the factors that influence preparedness relate to people with disabilities and how these factors may influence how this population prepares for disasters.

**Disabilities and Disaster Vulnerability**

When government authorities issue evacuation orders, it is critical that citizens respond accordingly. Unfortunately, the functional limitations experienced by people living with disabilities can interfere with their ability to comply. Several researchers have noted the challenges of evacuating persons with physical disabilities. In a qualitative study among people with mobility impairments who experienced a disaster, being physically unable to evacuate due to power shutdowns was one of the key barriers noted from open-ended survey responses.[41] For example, one respondent was unable to evacuate during a fire drill at work because she was in a wheelchair and the elevators stopped working.[41] Having physical disabilities was also one of the frequently cited reasons for not evacuating before Hurricane Katrina struck New Orleans.[42–44] Other types of impairments, such as those that interfere with information processing, can also hinder evacuation behaviors. In a book examining the impact of disasters among people with

disabilities, Kelman and Stough present several accounts of failed risk communication, such as the experience of a deaf woman who did not hear a fire alarm while staying at a hotel.[25] Impaired memory and reasoning, such as having dementia, have also been noted as barriers to safe evacuation during hurricanes.[45]

Even among people with disabilities who are able to comply with evacuation orders, the lack of accessible shelters and housing poses another challenge for safe disaster response.[41] In a study that used an open-ended internet survey among people with mobility impairments who had experienced a disaster, several respondents noted that shelters or other places they were referred to were not adequately prepared to accommodate their conditions. For instance, temporary shelters did not possess ramps for the use of wheelchairs or scooters and did not have provisions for service animals.[46] During Hurricane Katrina, only 1% of temporary housing units were deemed accessible, which resulted in a lawsuit against FEMA.[47] This lawsuit resulted in changes in the way the federal government delivers temporary housing; however, a more recent analysis of FEMA's disaster housing policy found that the agency is still inadequately prepared to meet the needs of people with disabilities.[48]

Studies of past disasters have also revealed that persons with disabilities experience heightened risk for disaster morbidity and mortality. During the 2010 earthquake in Haiti, it was estimated that nearly 1 million people with disabilities were injured by falling buildings and debris, leading to death or the development of additional disabilities.[26] Mortality data from Japan's 2011 earthquake, tsunami, and nuclear disaster also demonstrated that the mortality rate was two times as high for people with disabilities than the general population.[49] In a population-based cohort study that examined mortality risk factors from the 1999 Taiwan earthquake, Chou

and colleagues found that people with mental health disorders, moderate physical disabilities, and who had been hospitalized just prior to the earthquake had the highest odds of mortality.[50]

Research has also demonstrated that disasters can lead to exacerbation of existing health problems. Indirect effects, such as loss of electricity, can cause people to endure extreme temperatures or interrupt the use of necessary medical equipment.[51] Lack of access to routine health care and chronic disease medications are some of the leading causes of disaster mortality, contributing to higher mortality among people living with pre-existing health problems.[51,52]

In addition to these vulnerabilities, local emergency management and response agencies are often not prepared to address the diverse needs of people with disabilities. In a study that surveyed and reviewed the emergency plans of 30 local emergency management agencies across the nation, Fox and colleagues found that only 27% of emergency managers completed federal training on the needs of people with disabilities. This study also found that there was little to no representation of persons with mobility impairments at the planning or revision stages of the emergency plan and that the majority of emergency managers did not know how many persons with mobility impairments live in their jurisdiction.[53] In other studies that have evaluated emergency medical relief practices from past disasters, researchers have found that access to and availability of prescription medications do not meet the needs of evacuees with chronic health conditions.[54–56]

Places that cater to people with disabilities, such as nursing homes, home-based primary care providers, and community-based organizations that serve the deaf or hearing impaired, have also been shown to lack the necessary plans and support to meet the needs of their vulnerable constituents.[45,57–59] While some emergency response agencies have started to adopt measures to enhance planning for people with disabilities, such as the development of registries of people

who need transportation or other assistance during a disaster, these measures are often difficult and expensive to maintain over time.[60] For example, emPOWER, an electronic health record system developed by U.S. Department of Health and Human Services and the City of New Orleans Health Department, uses Medicare claims data to identify individuals with electricity-dependent medical equipment.[61] While the initial pilot testing in New Orleans in 2013 found that first respondents could use the information to go door to door and accurately identify vulnerable residents 93% of the time, the reach of the system is limited by the lack of resources of local public health agencies to maintain and update registry on an ongoing basis. Federal policies, such as the Presidential Executive Order 13347, which requires that planners "increase the rate of participation of people with disabilities in emergency planning, preparedness, response and recover drills and exercises," also acts more of a call to action that a specific set of requirements that agencies need to adopt.[47] Further guidelines and organizational policies are thus needed to enhance the capacity of emergency management and community-based agencies to address the needs of people with disabilities.

**Preparedness Behaviors in U.S.**

*Household Preparedness in the U.S.*

An all-hazards approach for preparing for disasters at the personal or household level consists of a specific set of recommended behaviors. The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) and the Centers for Disease Control and Prevention (CDC) advise that each household make emergency plans, possess a disaster supplies kit, and stay informed about local disasters.[31] Household emergency plans consist of arranging ways to receive emergency alerts and warnings, planning for potential sheltering and evacuation, and developing a plan to communicate with household members and

loved ones during a disaster.[31] A disaster kit should contain supplies that could allow individuals and families to fend for themselves for at least 3 days following a major disaster. According to FEMA, a basic kit should include a 3-day supply of non-perishable food, a 3-day supply of water, a battery powered or crank radio, a first aid kit, a flashlight with extra batteries, a whistle, dust masks, wet wipes and other personal sanitation items, a manual can opener for food, local maps, a wrench or pliers to turn off utilities, and a cell phone with charger or a backup battery. There are also a number of other supplies that are recommended depending on the needs of the household, such as prescription medications for people with chronic conditions.[55,62] Finally, FEMA and the CDC advocate that before a disaster strikes, individuals and families need to stay informed about potential disasters in their neighborhood, how to get emergency alerts, and where to go if they need to evacuate.[63,64]

While that goal of preparing for disasters is to build citizen capacity to better respond to and protect against the impact of disasters, it must be recognized that there is a gap in the literature evaluating these outcomes. Much of the disaster research has neglected to assess whether preparing for disasters improves emergency response capacity and relies on untested assumptions that individual preparedness and self-sufficiency contributes to overall community resilience to disasters.[65] Furthermore, studies have generally not examined the direct relationship between preparedness and key health outcomes. For example, in an a review of the disaster preparedness literature, Heagele highlights the lack of evidence supporting the effectiveness of disaster kits, as well as a consensus regarding what items should be stockpiled to enhance survival and resilience after a disaster.[66] This review highlights the need for additional research examining whether there is an association between preparedness and disaster related morbidity and mortality, particularly among medically frail community members who experience grater

disparities in disaster health outcomes.[66] While considering the current rates of preparedness is still essential to understanding overall vulnerability to disasters, these limitations in the disaster preparedness research must be acknowledged.

Research examining whether U.S. households follow the preparedness recommendations demonstrates that most people do not partake in these behaviors. FEMA's 2009 Citizen Corps National Survey, which examined personal preparedness among a nationally representative sample of 4,461 U.S. households, found low rates of household planning, with less than half respondents (44%) reporting that they have a household emergency plan "that included instructions for household members about where to go and what to do in the event of a disaster."[67] The same survey also found that the most of households were not informed about where to get information about disasters, with only 50% of respondents reporting familiarity with alerts and warning systems, 34% with information regarding local hazards in their area, and 38% with official sources of public safety information. A greater percentage of people (57%) indicated that they had "supplies set aside in their home to be used only in the case of a disaster;" however, most of the supplies consisted of packages foods and bottled water, with many fewer respondents possessing other important items, such as first aid kit (39%) or portable radio (20%).[67]

FEMA's 2012 National Survey, which included several of the questions asked in the 2009 Citizen Corps National Survey, also provided evidence of worsening or stagnant rates of certain preparedness behaviors. For instance, only 52% of respondents reported having disaster supplies (5% decrease) and 43% having a household plan (1% decrease). However, the number of people following the "stay informed" recommendation increased, with 55% of respondents

being familiar with alerts and warning systems (5% increase) and 46% with what local hazards are (12% increase).[35]

Other researchers have conceptualized personal emergency preparedness by developing scales or indexes to represent household's level of preparedness. These measures assume a more holistic view of preparedness by stressing the importance of following multiple recommended behaviors in order to be sufficiently prepared for a disaster. For instance, if a household possesses a flashlight and a radio but no extra supplies of water and non-perishable foods, it would be difficult for its members to be self-sufficient during a disaster. By treating preparedness as a continuous variable, one can better gauge where individuals fall on the preparedness spectrum.

In a study that surveyed a nationally representative sample U.S. households, Murphy and colleagues used mean scores to depict whether respondents had different emergency supplies and developed different household plans.[68] When asked about whether they had 18 types of emergency supplies that have been recommended by the CDC, respondents only had an average of 8.1 items.[68] Respondents were also asked whether they had developed each of the following types of plans: 1) a prearranged meeting place for family members (other than their home); 2) a prearranged out-of-town contact person for family members to check in with; 3) an evacuation plan for their home; 4) and copies of essential documents such as birth certificates, insurance policies, and titles in a safe place outside their home. Using a plan score ranging from 0 (had no plans in place) to 4 (all), respondents had an average plan score of 0.65.[68] Using these measures, we can see that U.S. households are typically better at stockpiling different supplies than developing disaster plans, which is consistent with what we see in individual measures of behavior included in FEMA surveys. We can also deduce that they tend to fall lower on the

preparedness spectrum, with participants only engaging in a minority of recommended behaviors. However, because measures are combined into indexes, it is harder to gauge which specific behaviors respondents are performing. For example, it is unclear which supplies households typically possess or whether there is a greater frequency of households with an evacuation plan versus copies of important documents. This remains one of the limitations of presenting preparedness data as multi-behavior indexes.

Other studies have used binary cutoff point to measure household preparedness in the U.S. By specifying a cutoff point which designates whether or not one is deemed adequately prepared, there is a more finite conceptualization of preparedness. While this binary measure can be more helpful for interpretation, it loses some of the information provided in a continuous measure. Additionally, the cutoffs may be chosen in a subjective manner as there is no universally accepted cutoff for what it means to be prepared.

In a study that utilized data from five states who completed the optional general preparedness module included in the 2006 Behavioral Risk Factor Surveillance System (BRFSS), Ablah et al. deemed respondents to be prepared if they were deficient in no more than 1 of the 6 preparedness action steps included on the BRFSS.[69] These steps included having an evacuation plan, a 3-day supply of water for all members of the household, a 3-day supply of non-perishable food for all members of the household, a 3-day supple of prescription medication for each person in household who takes prescribed medicines, a working battery operated radio, and a flashlight. Based on this study's criteria, only 45% of the respondents were considered prepared.[69] When presented in this binary form, we see that slightly less than half of American households are prepared. This value is similar to some of the individual preparedness behavior measures included on FEMA surveys, which is likely due to the fact that the six behaviors within

this measure include having the more common household supplies as well as having a generic evacuation plan. On the other hand, this value appears much higher than Murphy et al.'s (2009) continuous emergency plan index, which includes more specific emergency planning behaviors, such as having a designated meeting location and having copies of important documents. By both including fewer of the specific recommended behaviors in this variable and then further reducing it to a dichotomous measure of preparedness, we lose some of the information provided in a summative index. This may be artificially inflating measures of holistic preparedness, making it look as though households are more "prepared" than is recommended.

*Household Preparedness in Southern California*

Disaster preparedness research has been predominantly conducted in regions prone to natural disasters. In particular, many studies have taken place in Southern California, a region threatened by earthquakes as well as a number of other natural hazards including wildfires, landslides, flooding, winter storms, severe freeze, and tsunamis.[70] The following review of the literature suggests that Southern Californians are more prepared when it comes to having certain recommended emergency supplies, but that rates of household plans are comparable or lower than those for the rest of the nation.

In a 2009 survey study of a weighted sample of Californians that aimed to represent the population, including a sample of six Southern California counties at high risk of earthquakes, Kano and colleagues found that 78% of Southern California respondents had a first aid kit, 90% had a flashlight with batteries, 69% had stored water, 74% had stored food, and 64% had a radio. When asked about where they preferred to receive warnings, alerts and notifications about disasters, about half of the respondents indicated the local fire department as their preferred source and about a third listed the television as their preferred communication channel. Planning

rates were generally lower with only 40% of Southern Californians having a family disaster plan, 60% making copies of important documents, and 15% making disaster plan for pets.[71]

In another survey conducted in Los Angeles County, Eisenman and colleagues similarly found that only 40% of respondents reported having a family communication plan.[34] A large majority of households also had five individual disaster supplies (3-day supply of food and water, a battery-powered radio, first aid kit, flashlight and extra batteries), but less than half of respondents indicated that they had all five of these items.[34]

FEMA's 2015 National Household Survey additionally supports the trend that residents of Southern California are more likely to possess certain emergency supplies, but are less likely to have household plans. Using an oversampling of U.S. residents with the highest expected incidence of earthquakes including counties in Southern California, this survey found that 64% of respondents possessed a 3-day emergency supplies kit. On the other hand, only 44% indicated that they had generic household disaster plans, 36% had plans for getting in touch with members of the household, 23% had plans for evacuation, and 27% had plans for checking in on neighbors.[72] One explanation for this trend is that developing specific disaster plans may require more complex forethought and motivation to prepare than a one-time purchase of common household supplies, such as a flashlight or first aid kit. This explanation is supported by Glik and colleagues' evaluation of a randomized controlled trial comparing the effectiveness of an intensive household preparedness education intervention that utilized *promotoras* versus a more basic household preparedness education treatment delivered through print media.[73] Guided by the Precaution Adoption Process, they found that there was a greater shift in behavior stage from baseline to follow-up for the intensive education arm, but the results were only significant for creating a family communication plan and not for having disaster supplies.[73] Making disaster

plans thus appears to be a more complex behavior that requires more intensive education to influence than simply having supplies, which may be simpler to understand and enact.[73]

Another recent study of a random sample of Los Angeles County residents suggests that fewer Southern Californians have household supplies (25%) and more have a family disaster plan (63%) than the rest of the country. While these results differ from other studies, the way the researchers measured disaster supplies and plans may be contributing to this finding. This study considered one to have sufficient disaster supplies only if they possessed all eleven potential items.[74] Their measure of household plans, like those used in much of the preparedness research, also only asked whether they have "a family plan in the event of a disaster" and does not specify whether this is a plan for communicating with loved ones, evacuating their homes, or planning on how to receive information. Greater specificity in the way these questions are worded could help improve our understanding of preparedness rates in Southern California and across the nation.

*Community Preparedness in the U.S. and Southern California*

Citizen engagement in disaster preparedness has recently started to focus more on engaging and empowering communities to become more prepared. In addition to making a plan, having supplies and staying informed, FEMA now recommends that citizens also get involved in community disaster planning. Community disaster planning behaviors include attending a first aid or CPR training, attending meetings that discuss and plan for disasters, talking to and working with neighbors to get prepared, and volunteering to support local emergency responders, disaster relief, and community safety through such organizations as the National Voluntary Organizations Active in Disasters (NVOAD) and Community Emergency Response Teams

(CERT).[32] These community-oriented approaches to disaster preparedness can help entire communities build the capacity to withstand and recover from disasters.[75]

Unlike personal or household preparedness which has been well studied, research assessing participation in community preparedness behaviors among the U.S. public is more limited. Nationally, FEMA's Household Survey has started to include a number of community preparedness measures. Results from the 2012 survey established that approximately one third of the population attended a CPR (35%) or first aid skills training (29%), reported talking about preparedness with others (31%), and attended a preparedness drill or exercise at their workplace, school or home in the past two years (33%). Nearly a quarter of the survey participants also attended a meeting that specifically focused on disaster preparedness (23%).[35] However, results from FEMA's more recent 2015 Household Survey found some decline in these measures with only 18% of respondents indicating that they attended a preparedness meeting or training within the past year.[72]

In Southern California, it appears that the public is typically more engaged in certain community preparedness behaviors but less involved in others. In a study that examined earthquake preparedness among sample of Southern Californians weighted to be representative of the population, Kano et al. found nearly two thirds of respondents had learned first aid and almost half participated in disaster preparedness activities at their workplace.[71] Participation in disaster response trainings, on the other hand, was much lower, with only 18% ever attending a disaster response training, such as those delivered by CERTs.[71]

Other researchers have conceptualized participation in community preparedness as one of the capacities needed to build a disaster resilient community.[76,77] Community preparedness variables have thus been included in several multi-component indexes and scales that have been used to

measure a community's baseline level of resilience.[78–81] Nevertheless, most of these studied instruments only measure perceptions of a community's organizational capacity to respond to disasters rather than actual participation in community preparedness efforts, such as attending disaster trainings and meetings. For example, the theoretically-driven Communities Advancing Resilience Toolkit Assessment Survey provides information on community strengths and challenges but is not intended as an outcome measure of resilience-building behaviors.[80] The Conjoint Community Resilience Assessment Measurement, a multifactorial index which has been validated against measures of perceived community resilience, also examines perceptions of community preparedness for emergency situations rather than participation in actual behaviors.[79]

One of the few tools that actually captures individual participation in community disaster planning is the Los Angeles County Community Disaster Resilience (LACCDR) Index.[78] This index was developed to measure changes in community resilience across sixteen neighborhoods in Los Angeles County before and after the implementation of an experimental intervention that utilized community coalitions, a resilience toolkit, and disaster preparedness training.[75,82] The Community Engagement domain in the LACCDR Index assessed participation in the following six community preparedness behaviors: 1) attending a community meeting where preparing for disasters was discussed; 2) working or volunteering to help their community prepare for or respond to a disaster; 3) working or volunteering with a group or organization that focuses on community safety, such as Neighborhood Watch; 4) attending a training to help others in their community, such as CPR or first aid; 5) attending a psychological first aid training; and 6) looking for information about disaster preparedness.[78] By calculating the average participation across these six behaviors, Eisenman and colleagues found that survey respondents only

participated in approximately one of these six behaviors.[78] This lower level of engagement may be due the fact that this measure includes more involved and collaborative community preparedness actions that require strong levels of community cohesion. This study also found that there was variation in community engagement among Los Angeles communities that differ in their cohesiveness. For example, respondents from Watts, which is a community with a history of civic engagement and community activism, participated in an average of 1.36 behaviors, whereas those living in Hollywood, a more transient neighborhood predominantly made up of renters,[83] only participated in an average of 0.71 behaviors.[78] These findings suggest that community engagement in preparedness is relatively low across the greater Los Angeles area, but that certain cohesive communities within the county may be more engaged in community preparedness efforts.

*Disaster Preparedness across Socio-Demographic Groups*

Much of the research examining disaster preparedness behaviors has focused on the varying levels of engagement across different socio-demographic groups. This research helps reveal which segments of population are better prepared for disasters and which may be at greater risk for their detrimental outcomes. Among the variables that are well studied are age, gender, race/ethnicity, income, education, presence of children in the household, and having a disability or health limitation.

Age is a factor that has been strongly linked to personal or household preparedness in the U.S. Several researchers have found that after controlling for other demographic characteristics, older age is positively associated with measures of developing emergency plans, stockpiling household emergency supplies, and being aware of hazards.[34,68,69,84,85] While the effect of age appears to peak somewhere after age 30, there is evidence that it declines again for elderly age

groups.[86] For instance, the 2012 National Household Survey, which used a representative sample of U.S. households, found that respondents aged 35 to 74 years were more likely to take the steps to prepare for a disaster than those 75 or older.[35]

These trends are particularly pronounced when examining the more involved community preparedness behaviors. The 2012 FEMA survey found that in comparison to respondents of every other age group, seniors over the age of 75 were the least likely to participate in a CPR training, a first aid skills training, a preparedness meeting or training, or a preparedness drill.[35] Another study conducted in Los Angeles County suggests that younger populations are more engaged in community capacity and skill-building behaviors. Using a cluster analysis that segmented the population into distinct resilience behavior patterns, Adams and colleagues found a decreasing age trend for those belonging to the cluster most active in preparedness trainings, community meetings, and volunteering.[87] These results remained significant even after controlling for different socio-demographic characteristics, suggesting that age has a robust effect on preparedness behaviors.

Gender is another demographic factor that has been studied in disaster preparedness research. Several studies have found that men are typically more prepared when it comes to personal disaster preparedness, such as having household disaster plans and supplies.[68,69,88] Other studies have also suggested that men and women perform distinct preparedness behaviors, with women more involved in behaviors to prepare their families while men are more engaged in technical aspects of preparedness, such as making improvements to the home.[89] When examining what accounts for the differences in these behaviors, researchers have shown that gender is strongly associated with different social cognitive factors that are conceived to influence disaster preparedness. For instance, in a study that tested a complex conceptual model for household

preparedness for terrorism among a representative sample of U.S. households, Bourque and colleagues found that the effect of gender on preparedness behaviors was almost completely mediated by knowledge and response efficacy.[88] Other studies have also demonstrated that women tend to have greater perceptions of the risk and severity of large-scale disasters.[89,90] Gender differences in the social cognitive factors related to disaster preparedness may therefore explain the different behaviors between men and women.

While research has consistently demonstrated that racial and ethnic minorities are more vulnerable to a range of events before and after a disaster,[91,92] it has also presented inconsistencies regarding participation in pre-disaster preparedness behaviors.[86] In several large studies that use multi-item scales to assess disaster plans and supplies, researchers have found that minorities are typically less prepared than white respondents.[34,36,68] However, other studies have reported no significant effects in multivariable models[69] or have found that minority groups have a higher incidence of preparing for terrorism.[93–95] For example, a cross-sectional survey of a sample of Los Angeles County residents found that in comparison to whites respondents, there was a higher proportion of Latinos and African Americans who indicated that they developed an emergency plan or purchased or maintained emergency supplies within the last year as a response to the possibility of terrorism.[93] A study in London also found that non-white participants were more like to gather emergency supplies several months after a the occurrence of a terrorist attack.[95]

Several studies have also shown that Latinos and African Americans are particularly involved in community planning for disasters. The 2012 FEMA National Household Survey found that while non-Hispanic whites were more likely to have a disaster plan and be familiar with local hazards and warning systems, Latinos were more likely to attend a preparedness

meeting or training.[35] In a representative sample of Los Angeles County residents, both Latinos and African Americans had greater odds of being in the most active community resilient cluster, which was characterized by participation in behaviors that help build a community's capacity and skills needed to respond to and bounce back from disasters.[87] One possible explanation for these findings is that certain minority groups may assume a more collective culture characterized by joint decision making and reliance on members of their social networks. Past studies have demonstrated that Latinos are more likely to rely on their social networks for disaster planning, communication, and decisions than white Americans.[96–99] A small (N=58) qualitative study of Hurricane Katrina evacuees who were predominantly African American (81%) additionally highlighted the importance of extended families and other members of their social networks when making important decisions about disasters, such as evacuation.[100] It is possible that within certain contexts, Latinos and African Americans assume a more collective approach to disaster preparedness and response, potentially contributing to findings of greater participation in community planning efforts than non-Hispanic whites.

As with most health behaviors, income and education are strongly associated with participation in disaster preparedness behaviors in the U.S. Several studies have supported the fact that both personal and community-oriented preparedness increase with greater income and education level.[5,34,35,67–69,86,87] Research suggests that having a greater household income is not only associated with an increase in participation in these behaviors, but that it also influences attitudes about the need to prepare for disasters, including risk perception.[35,67] Education has also been shown to be positively associated with knowledge about how to prepare as well as negatively associated with reliance on emergency responders during a disaster.[67]

Households with children in the home are more vulnerable to the impact of disasters and thus important to study in the context of household preparedness. Using a nationally representative sample of U.S. households, Murphy and colleagues found that households with children younger than 18 years were positively associated with having a household emergency plan, but not possessing supplies or complying with authorities during an emergency.[68] Other regional U.S. studies have found that households with children are more prepared when looking at multi-item indexes of preparedness.[74,101] One of the proposed explanations for heightened preparedness is that they have greater perceived susceptibility to disasters. However, the literature examining this relationship is mixed, with some studies finding heightened perceived risk for volcanoes [102] and earthquakes,[103] while others have found no significant effect.[104–106] A qualitative study of a small sample of homeowners in Atlanta also suggests that children may be a source of information for their parents through their children's school or involvement in community groups, such as the Boy and Girl Scouts.[107] In fact, FEMA's 2012 National Survey found that 43% of respondents cited their child's school as a source of preparedness information.[35] Having children in the house may therefore act as both a motivator for household emergency planning as well as a potential source of information about how households should prepare.

*Disaster Preparedness among People with Disabilities*

Individuals with disabilities are at greater risk for harm during the various stages of a disaster.[20] Despite their enhanced vulnerability, researchers have found that those with health limitations perceive themselves to be less prepared. In a study that examined disability and preparedness using the CDC's 2006–2007 BRFSS, Smith and Notaro found that those with physical limitations, chronic medical needs, and mental illness were significantly more likely to

report that they were "not prepared at all" for an emergency in comparison with the general population.[36]

A number of other studies have found that physical and mental health limitations are negatively associated with self-reported preparedness behaviors at the household and community level. In a nationally representative sample of older adults that used an 18-item household disaster preparedness index, Al-rousan and colleagues determined that respondents with lower self-rated health, a greater number of limitations in activities of daily living, and more limitations in instrumental activities of daily living possessed significantly lower mean preparedness scores.[84] In a study of Hurricane Katrina evacuees, Spence and colleagues also found that a smaller proportion of respondents with disabilities reported having an evacuation plan (34%) than those without disabilities.[37] The 2012 FEMA National Household Survey additionally demonstrated that respondents with a disability were less likely to attend a CPR training and a first aid skills training than those who did not have a disability or who cared for someone with a disability.[35]

Even in multivariable models, there is evidence that disability is negatively associated with preparedness. In a study that used the 2010 BRFSS survey, Bethel and colleagues found that those who rated their health as fair or poor, indicated they had a disability, and had three or more chronic diseases were less likely to have four emergency supplies items (water, food, flashlight, radio) after controlling for age, gender, marital status, household income, and race/ethnicity.[33] In another study that took place in Los Angeles County, Eisenman and colleagues found that after controlling for several socio-demographic characteristics, lower self-rated health was negatively associated with developing a disaster plan in the past two years and

having emergency supplies. Having a serious mental illness was also negatively associated with having emergency supplies.[34]

Other studies of disability and health status, however, have found non-significant associations with certain preparedness outcomes. For instance, Eisenman el al. found non-significant relationships between disability status and having a disaster kit or developing a disaster plan when disability was measured by answering "yes" to at least one of the following questions: 1) Are you limited in any way in any activities because of a physical, mental, or emotional problem?; 2) Do you now have any health problems that require you to use special equipment such as a cane, a wheelchair, a special bed, or a special telephone?; and 3) Do you consider yourself a person with a disability?[34] In another study that used a random digit telephone survey conducted in Pennsylvania, households that indicated that they would require assistance to evacuate due to a medical needs were not significantly associated with purchasing food and water, having an evacuation plan, arranging a place to meet, locating a shelter, packing an emergency bag, or being aware of evacuation routes.[108]

Another study that used BRFSS data from six states even suggests that respondents with a disability that requires medical equipment, as well as those with diabetes, cardiovascular disease, and prior experience with a fall, were more likely to participate in at least five out of six CDC recommended preparedness actions, including having a disaster evacuation plan and a 3-day supply of water and non-perishable food.[69] Eisenman et al. also found that having a physical disability was positively associated with developing a terrorism emergency plan within the last year among a sample of Los Angeles County residents selected through a random-digit telephone survey.[93]

While there is greater evidence to suggest that people with disabilities are less likely to prepare for disasters, the inconsistency in these findings may be related to the diverse ways that disability status is being measured. People with health limitations do not simply fall within a dichotomous category of being disabled or non-disabled. Self-rated health, presence of a chronic health condition, having a physical health limitation, and possessing a cognitive disorder are all examples of the different ways that health can interfere with daily functioning. Variation in these measure may therefore contribute to different effects on disaster preparedness behaviors. For example, in Eisenman et al.'s (2009) study, they combine different measures of disability status, including whether respondents consider themselves to be a person with a disability and whether they possess health problem requiring special medical equipment. These measures of disability are likely associated with different perceptions and understanding of disability status, so combining them into a single measure may contribute to potentially null associations between different preparedness behaviors. In fact, Ablah et al.'s study of BRFSS data from six U.S. states, which kept these same measures of disability status as separate predictors in multivariable models, found evidence of opposing results. Considering yourself a person with a disability was negatively associated with participating in at least five out of six CDC recommended preparedness actions while requiring special medical equipment was positively associated with the preparedness outcome. Keeping these measures separate when studying their relationship with preparedness may therefore be more informative to understanding how nuanced differences in measures of disability status influence participation in disaster preparedness behaviors.

**Social Cognitive Variables that Influence Disaster Preparedness**

To better understand what motivates one to get prepared for disasters, researchers have examined how social cognitive characteristics and other environmental factors influence

participation in these behaviors. Among the most studied variables are knowledge about disasters and preparedness, risk perception, prior disaster experience, government trust, self-efficacy, perceived response efficacy, and social capital. Several of these variables have also been studied within the context of disabilities, elucidating what factors might influence preparedness among this vulnerable segment of the population.

*Knowledge and Disabilities*

The idea that knowledge precedes behavior is something that is rooted in the knowledge-attitude-behavior continuum posited by several behavior change theories (e.g. Theory of Planned Behavior[109]). Awareness about hazards, as well as knowledge about how to best prepare for and respond to a disaster, are thus important antecedents to actually engaging in preparedness behaviors. In terms of awareness about potential hazards, studies suggest that exposure to multiple sources of information increases the likelihood of having a disaster plan[74] and having more supplies.[68] However, exposure to information alone may not provide enough knowledge or motivation to prepare, with studies suggesting that individuals must seek additional information (i.e. milling behavior)[110] or receive encouraging information from members of their social networks to actually influence preparedness actions.[111]

In literature reviews of studies that examine predictors of household preparedness, several researchers have found evidence linking knowledge about hazard-mitigation and preparedness behaviors.[5,86] For example, in a study examining knowledge about earthquakes, Hurnen and McClure found that greater knowledge about how to prevent earthquake damage was positively associated with a multi-item preparedness activity score that included measures of stockpiling supplies, developing emergency plans, and securing dangerous objects.[112] Other studies have also suggested that preparedness knowledge is associated with perceptions of risk

and subsequent pathways that motivate individuals to protect themselves.[90,113] Possessing, searching for, and processing information about disasters and preparedness may therefore influence participation in disaster preparedness behaviors.

Disaster preparedness knowledge among those with disabilities is something that was measured by FEMA's 2012 National Survey. The survey assessed knowledge about the risk and recommended behaviors of how to respond to two types of disaster, earthquakes and tornadoes. Results from the survey found that the majority of individuals with a disability, which was measured as having a "disability or health condition that might affect their capacity to prepare for or respond to an emergency situation," correctly answered information about what to do during an earthquake, including getting under a piece of furniture (69%), holding onto something (58%), and getting close to the ground during an earthquake (58%).[35] Knowledge about not standing in a doorway was lower (40%), but still higher than respondents who did not have a disability or who were caring for someone with a disability (30%).[35] Most respondents with disabilities also correctly responded that they should not open their windows during a tornado (65%), which was comparable to those who do not have a disability or care for someone with a disability (64%).[35]

In another study that tested the effectiveness of an educational disaster preparedness program among a small sample of Los Angeles residents with intellectual and developmental disabilities, Eisenman and colleagues measured baseline levels of earthquake preparedness knowledge. Using a test that assessed what 1) items to put in an emergency backpack, 2) what they should do during an earthquake in different scenarios, and 3) who they should contact after an earthquake, they found that at baseline respondents in the experimental arm scored a 79 out of 100.[114] Although this study did not examine how knowledge influenced preparedness, it found

that the peer-led educational classes both increased knowledge and self-reported participation in disaster preparedness behaviors, suggesting that the positive relationship between disaster knowledge and preparedness behaviors also holds true for those with intellectual and developmental disabilities. Given the evidence of relatively high knowledge about disaster preparedness among those with different types of disabilities, it is possible that other social cognitive factors may be contributing to their lower level of preparedness.

*Risk Perception and Disabilities*

After learning about disasters, individuals will start to develop beliefs regarding their level of threat. Researchers have coined the term risk perception, which often encompasses both beliefs about the probability that an event will happen as well as its potential severity.[90] Risk perception is an important construct included in several well-established behavior theories and models, including the Health Belief Model,[115] Protection Motivation Theory,[116] and Protective Action Decision Model.[117] Given the inherent risk of disasters and the need to motivate people to prepare in advance, a number of researchers have applied these theories to study how perceived risk influences preparedness behaviors.

Several studies have found that greater perceptions of threat from different hazards is positively associated with engaging in disaster preparedness and response behaviors, including evacuation[118,119] and preparing the household by having a plan and supplies.[93,120–122] In fact, underestimating the risk was one of the reasons that victims of Hurricanes Katrina provided when describing why they did not evacuate in time.[100] However, the risk perception literature is mixed, with other researchers finding no direct statistical association between risk perception and behavior.[90,105,123,124]

There are several explanations for these inconsistent findings. In certain instances, models have shown that other variables completely account for the effect of risk perception on preparedness. For example, Bourque et al. found that it was completely meditated by knowledge, perceived efficacy, and milling behavior.[90] Other studies have noted that the different ways that risk perception has been measured by surveys may lead to differing results.[122,123] Finally, there is also the possibility that perceived risk may increase protective behaviors, which may in turn reduce feelings of threat due to heightened level of preparedness. Risk perception is therefore a difficult variable to study in the context of disaster preparedness as there may not be a linear correlation.

FEMA's 2011 Household Survey examined risk perception for different hazards and disasters among respondents who indicated that they had a disability or health issue that could influence their ability to prepare or respond. When asked about their beliefs about being at risk for a disaster, rates were higher for those with a disability than for the rest of the population, with 48% (vs. 39%) indicating that they believe they are at risk for natural disaster, 25% (vs. 21%) for hazardous materials, 27% (vs. 16%) for disease outbreak, and 23% (vs. 12%) for a terrorist act.[125] The percentage of people with disabilities who believed the disaster will be severe was also higher than the rest of the population with rates ranging from 41% to 69% across types of hazards and emergencies.[125] In another study that examined perceived level of threat for terrorism among a random sample of Los Angeles residents, Eisenman and colleagues similarly found that individuals with disabilities and health limitations had greater perceptions of risk of terrorism than those who did not.[34] Respondents with disabilities also had higher odds of often avoiding public activities because of terrorism concerns, even after controlling for other demographic variables related to disaster vulnerability.[34] When asked to rate the terrorism threat

level using the federal government's color-coded alert system, a greater proportion also rated the current level of threat as high, though these results were non-significant.[34] Results from these studies suggest that individuals with disabilities have greater perceptions of threat regarding diverse types of disasters.

*Past Experience and Disabilities*

Fully understanding the threat of disasters can result from having lived through a disaster experience. Past experience with a disaster or other emergency can thus motivate decisions to prepare for next time, an idea theorized by several prominent disaster researchers.[4,126] Several studies have demonstrated that prior experience with a large-scale natural disaster, such as a hurricane or earthquake, can increase participation in pre-disaster preparedness behaviors.[85,122,127–130] Experiencing both physical and emotional damage caused by a disaster is also something that has been shown to increase household preparedness as well as one-time mitigation actions, such as making structural improvements to the house and buying insurance that covers disaster damage.[131–133] It is hypothesized that direct experience with a disaster can influence risk perception, though often additional social cognitive influences surrounding the behavior are needed to actually motivate participation in preparedness behaviors.[4]

In a qualitative study that examined disaster experiences among individuals with different types of physical disabilities, some of the lessons learned point to the influence that prior experience has on risk perception and attitudes about pre-disaster planning.[41] Many of the respondents described bad experiences they had during disasters, such as being left behind during evacuations and not being able to find temporary housing that was accessible. As a result of these harrowing experiences, they expressed the need to plan better for evacuation and to have the appropriate equipment on hand. Fewer respondents (21%), however, explicitly reported that

the disaster experiences led to increased participation in home and community preparedness, suggesting that additional motivators may be needed to influence these behaviors.[41]

Other studies that have examined the influence of prior disaster experience among people with disabilities have predominately framed it from the point of view of emergency management agencies. There is evidence suggesting that agencies have started to plan better for people with disabilities as a result of these experiences (e.g. Aldrich & Benson (2008)[134]), but less is known about how preparedness behaviors have changed among those with health limitations with prior disaster experience.

*Trust in Government and Disabilities*

Trust in government refers to a complex measure related to perceptions about the government's ability to adequately and appropriately respond to the public's needs during a disaster. Many studies have shown that government trust influences behaviors related to preparedness and response across a wide range of public health emergencies. When examining confidence in the government's ability to manage disasters, several studies have shown that confidence is positively associated with participation in preparedness actions, including possessing household supplies and a family hurricane plan.[68,74,86] Using the Public Health Disaster Trust Scale, which treats government trust as a multi-dimensional measure of competency, honesty, fairness and confidentiality, Eisenman et al. found that having a higher score was associated with agreeing to follow hypothetical public health evacuation recommendations as well as engaging in household preparedness behaviors.[135] A shortened version of this scale additionally demonstrated that trust in the public health department further enhances engagement in more community-oriented preparedness behaviors, such as attending trainings and helping the community prepare for a disaster.[87]

In addition to influencing behaviors in preparation for a disaster, government trust is also important for motivating the public to respond to disaster warnings.[20] For instance, distrust of authorities is one of the often cited reasons for why certain people did not evacuate during Hurricane Katrina.[100] In fact, low government trust among certain demographic groups, including African Americans, acts as a major barrier to getting citizens engaged in disaster preparedness and response.[135,136] Beliefs about government public health and emergency response agencies is therefore an important variable to consider when trying to understand and influence preparedness behaviors.

Few studies have elucidated how government trust influences preparedness among people with disabilities. In a study that used BRFSS data from 2006-2007, Smith and Notaro found that the percentage of people who indicated that they lacked trust in public officials was higher for people who were limited due to physical, mental or emotional problems, but the results were non-significant. In another study that examined preparedness among households who indicated that they require assistance in order to evacuate due to a medical need, they also found no significant relationship with willingness to listen to a government evacuation order.[108]

In terms of believing the government will help them in the event of disasters, researchers have found that this was something that was expressed by people with disabilities following Hurricane Katrina.[25] However, others have also noted low levels of confidence in the government after Hurricane Katina, which may be related to the specific mishaps that occurred during the response of this disaster. For instance, in a national study of people with disabilities that examined levels of confidence in the government several months after Hurricane Katrina, only 38% of respondents felt they could sufficiently rely on the federal government, 41% on the state government, and 40% on the local government to help them prepare for disasters. These

percentages were much lower than for community-based organizations such as non-profits and faith-based organizations.[137] Unfortunately, data on government trust among people with disabilities prior to Hurricane Katrina is not available, so comparisons before and after the event cannot be made.

*Self-Efficacy and Disabilities*

Self-efficacy, or beliefs about one's ability to effectively engage in a behavior, is an important social cognitive factor for disaster preparedness. In Paton's social-cognitive preparation model,[138] which adapts elements of Bandura's social cognitive theory[139] to the context of disasters, self-efficacy acts as one of the key constructs influencing intentions to prepare. He posits that people are motivated to prepare by their perceptions of disaster risk and knowledge about hazards. Individuals will then form behavioral intentions only if they have adequate expectations about being able to perform the behavior (i.e. self-efficacy). Others have conceptualized self-efficacy as a key factor motivating individuals to move through behavioral stages of preparedness. For example, in an intervention study guided by the Precaution Adoption Process Model that focused on enhancing preparedness among a sample of Latinos in Los Angeles County, Glik colleagues found that individuals with greater perceived self-efficacy were more likely to shift to having a disaster communication plan over time.[73]

When self-efficacy is included as a variable in disaster preparedness survey research, it has been found to be positively associated with possession of emergency items, development of an emergency plan, stage of emergency preparedness, as well as measures of resilience following a disaster.[20,73,140,141] While less studied in the context of community-oriented preparedness, one survey study in Los Angeles County suggests that self-efficacy also has a positive influence. Using a measure of self-efficacy that both examined participants' confidence in their ability to

adequately prepare themselves for a disaster and their ability to assist others, higher self-efficacy was associated with belonging to an audience segment that participates in both household and community-based preparedness behaviors, including attending CPR and other trainings.[87] Self-efficacy is also a theme that has been brought up in qualitative research. When asked about their beliefs and competencies that influenced their preparedness behaviors in qualitative interviews, a sample of residents from three urban locations in New Zealand subject to seismic risk described that they felt that they could engage in these actions with relative ease and without major hindrances.[142] Results from these studies demonstrate that regardless of how it is measured and in what context it is studied, there is evidence linking self-efficacy to preparedness behaviors.

Understanding how people living with disabilities perceive their ability to perform disaster preparedness behaviors can help illuminate how to best influence their behavior. FEMA's 2011 Household survey found that only 65% of Americans who self-report as having a disability believed they know how to get prepared.[125] Results from this survey also found that those with a disability were less likely to perceive that they could respond to a diverse set of disasters and hazards in comparison to people without disabilities. When asked if they "believed they could respond," 61% said yes for a weather emergency, 47% for a natural disaster, 51% for a flood, 41% for a wildfire, 33% for a disease outbreak, 20% for a hazardous materials accident, and 25% for a terrorist act.[125] For most of these hazards, self-efficacy to respond was lower for people with disabilities than for the general population, except for hazardous materials and terrorism, which were slightly higher. Personal accounts from survivors of disasters with physical impairments have additionally described how they have lost their confidence in their ability to keep themselves safe.[143] Despite evidence of lower self-efficacy among this vulnerable

population, there is no current literature that specifically examines whether self-efficacy mediates the relationship between disability and preparedness behaviors.

*Response Efficacy and Disabilities*

Response efficacy denotes perceptions about how engaging in protective behaviors will effectively lead to intended outcomes. Often additionally referred to as outcome or behavioral efficacy, it denotes beliefs about the effectiveness of behaviors to promote health or protect against risk. As described in Paton's social-cognitive preparation model[138] as well as more general behavior theories, such as Rogers' Protection Motivation Theory,[116] response efficacy is an important precursor to actually engaging in protective behaviors.

Several researchers have studied how perceptions of specific disaster preparedness and response behaviors influence their participation in these actions. In a study among Los Angeles university students that examined perceptions about the efficacy of earthquake preparedness, Lindell and Whitney found that perceiving that preparedness can both protect people and property from harm were positively correlated with a 12-item scale of earthquake preparedness behaviors.[123] Behaviors in this scale included possessing different supplies, having a household emergency plan, learning the location of nearby medical emergency centers, attending meetings on earthquake emergency preparedness, strapping water heaters and other unstable objects to walls, installing cabinet latches, and purchasing earthquake insurance.[123]

Other researchers have similarly confirmed that response efficacy increases the number of preparedness actions taken.[140] In another study that tested a conceptual model linking risk perception and terrorism preparedness among a nationally representative sample, Bourque and colleagues measured response efficacy by asking respondents to rate the effectiveness of four types of behaviors for preparing for a terrorist act (emergency plans, stockpiling supplies,

purchasing things to make them safer, and duplicating important documents).[90] Using an index that combined these four measures, they found that response efficacy had a strong direct relationship with participating in the four preparedness actions and also mediated the effect of risk perception.[90]

In another study that asked more generally about perceptions of the value of complying with specific instructions from the government, Murphy el al. found that higher response efficacy was positively associated with having more emergency supplies.[68] Even among those already highly engaged in preparedness, greater response efficacy can contribute to more involvement in different preparedness behaviors. For example, in a study that examined a sample of Los Angeles residents who registered for an earthquake drill and campaign that taught and promoted preparedness, greater engagement in some of the campaign's diverse activities, such as playing educational games and working with others to prepare, was positively associated with an multi-item response efficacy index.[144]

Qualitative research has additionally confirmed the importance of response efficacy in influencing preparedness. Using open-ended interviews that examined beliefs about earthquake risk and behaviors among a sample of New Zealand residents subject to seismic risk, Becker et al. found that respondents who engaged in preparedness behaviors believed they could reduce the impacts of hazards, protect personal safety, and ensure survival.[142] Results from these different ways of measuring and analyzing response efficacy support the notion that it is an significant variable to include in preparedness models.

Though not extensively researched, some studies have examined response efficacy of disaster preparedness among individuals who have disabilities. In a qualitative study that aimed to understand preparedness behaviors and difficulties faced by persons with mobility

impairments who have previously experienced a disaster, Rooney and White found that some participants had strong beliefs that their chances of survival can be increased by gathering general disaster supplies and developing disability-specific evacuation plans before a disaster strikes.[41] This study, however, was only exploratory and did not examine how these perceptions influenced actual behaviors.

FEMA's 2011 National Survey additionally collected data on disaster preparedness perceptions and behaviors among respondents who self-reported having a disability or health condition that might affect their capacity to prepare for or respond to an emergency situation. Results from this survey demonstrate that those who are disabled are less likely than non-disabled respondents to believe that preparing helps across a wide range of emergencies, including natural disasters, terrorist acts, and different hazards such as wildfires and floods.[125] Nevertheless, research examining whether the relationship between disability status and preparedness is mediated by lower response efficacy is still lacking.

*Social Capital and Disabilities*

Social capital is a complex construct with several different meanings that can vary according to distinct theoretical perspectives. Assuming an inclusive conceptualization proposed by James Coleman's Theory of Social Capital, social capital encompasses the various functions inherent in one's social network, such as the norms, information, support, and other types of resources it can provide.[145] While it appears as an aspect of social structure, individual actors are able to use social capital as a resource to achieve their goals.[146] Social capital can thus facilitate individual disaster preparedness and response in several ways. For instance, people can gain or actively seek information from members of their network both when preparing for a disaster (e.g. what items should go in an emergency kit) and during a response (e.g. when to evacuate). Social

networks can also influence decisions about preparedness and response by reinforcing norms and expectations surrounding behaviors. Furthermore, social capital includes the additional resources and support that can facilitate preparedness and response behaviors. For example, emergent organizations are groups of people that develop to help others in the wake of a disaster when responders are unable to address community needs.[147] The information potential, norms, resources and support that social networks can provide have motivated researchers to study how different elements of social capital influence emergency preparedness and response behaviors.

The literature examining how the different aspects of social capital influence disaster preparedness and response produces mixed results. When assessing the size of one's social network, one study found that simply having a large social network did not enhance evacuation behaviors during two major hurricanes that struck the Southeastern part of the U.S.[148] In fact, a qualitative study of people who did not evacuate during Hurricane Katrina found that many people stayed due to decisions made by members of their extended network.[100] Research demonstrates that people tend to make decisions about evacuation as a family unit,[149,150] so behaviors may be either hindered or supported by the network depending on member needs, limitations, and beliefs.

In terms of how information and norms from social networks influences preparedness, Wirtz and Rohrbeck found that informational social influence, measured as knowing anyone who had taken preparedness actions, had a positive association with both intention to prepare and the number of preparedness actions taken after controlling for other demographic and cognitive variables.[140] The existence of supportive neighborhood networks has also been shown to increase engagement in diverse preparedness behaviors. In a study conducted among a representative sample of Los Angeles adult residents, Adams et al. found that respondents who knew 10 or

more people in their neighborhood from whom they could ask a favor were more likely to belong to the population segment that was most active in household preparedness, communication about disaster planning, and building community capacity to respond.[87] FEMA's 2012 National Survey additionally found that support and communication with members of one's social networks can motivate individuals to prepare. When asked who motivated them to engage in preparedness actions, 17% of survey respondents listed their responsibility to take care of their family, while fewer reported that people at work or school (6%), a family member or friend (4%) or a trusted leader (2%) motivated them to prepare.[35]

One of the proposed explanations for how supportive social networks can influence preparedness behaviors is through the concept of milling, the active seeking of information about hazards and preparedness. In Rogers' Diffusion of Innovation Theory, "confirmation" is a process that describes how individuals seek to affirm their decision to adopt a new behavior.[151] The disaster literature demonstrates that preparedness can be influenced by first receiving information that later motivates people to engage in milling behaviors with their social network in order to affirm the appropriateness of engaging in disaster preparedness behaviors.[110,131,152] The existence of supportive social networks, including those in one's neighborhood, may therefore allow individuals to seek and validate information about preparedness, which may ultimately influence their behavior.

While less studied in the context of pre-disaster preparedness, several studies examine the importance of social capital for individuals with disabilities during and after a disaster. In a qualitative study that examined disaster experiences of individuals with mobility impairments, Rooney and White found that respondents were assisted by spontaneous networks of family, friends, neighbors, coworkers, and strangers during and after the disaster.[41] This finding has been

supported by case studies of disasters demonstrating how both informal and formal social networks (e.g. support groups) can help with evacuation and recovery.[20,25,153]

FEMA's 2011 National Survey has additionally examined how individuals with disabilities expect to rely on other people in the first 72 hours following a disaster. Interestingly, individuals with disabilities were less likely to expect that they would rely on household members (61%) or neighbors (44%) than those without disabilities (76% and 46%, respectively).[125] However, they did indicate they would rely more on state and federal government agencies, as well as non-profit, faith-based, and community-based organizations than the general population.[125] Social capital, as measured as additional support from others during the different stages of a disaster, appears to play a critical role in disaster response among people with disabilities. Nevertheless, it is still unclear whether social capital can also influence pre-disaster preparedness among this population.

**Gaps in the literature**

The disaster literature provides substantial evidence supporting the fact that people with disabilities experience high vulnerability before, during, and after a disaster strikes. Despite the greater susceptibility to harm, studies have found people who possess varying degrees of disability are less likely to report they are prepared, possess certain household disaster supplies, have a disaster or evacuation plan, and engage in preparedness trainings in CPR and first aid skills. Although there are some inconsistencies in these findings, they are likely the result of different measures of both disability and preparedness. Living with a disability or health limitation can mean a lot of different things to different people. Measures of disability that simply ask whether a respondent is disabled may not capture the degree of health limitations that limit daily functioning and place certain people at greater risk for the negative consequences of

disasters. It is thus helpful to use a variety of disability variables to study the nuanced differences in their relationship with preparedness. Additionally, most of the preparedness scales and indexes only examine some household preparedness behaviors, with inconsistent measures being used. They often do not incorporate measures of community disaster planning, an important FEMA recommendation for enhancing community disaster resilience. Actions such as talking about evacuation plans with neighbors and attending community disaster meetings are especially valuable to people living with disabilities, who may need additional assistance from others during a disaster. Considering both household and community preparedness behaviors would therefore be a more appropriate way to study the relationship between disabilities and disaster preparedness.

Research points to a number well established social cognitive and environmental factors that have been linked to preparedness behaviors, some of which have been studied among people with disabilities. In particular, several studies have shown that beliefs about the ability to perform a behavior (i.e. self-efficacy) and perceptions about the effectiveness of the behavior to achieve desired outcomes (i.e. response efficacy) are lower among people with health limitations. However, empirical studies of people with disabilities that examine pathways linking self-efficacy or response efficacy to preparedness behaviors are lacking. Additionally, the provision of resources and information from one's social network (i.e. social capital) appears to play an important role in helping people with disabilities evacuate during disasters. The potential for social capital to influence pre-disaster preparedness behaviors among people with disabilities, however, is less understood. Research specifying and testing the mediating or moderating pathways is therefore needed to better understand the potential barriers and motivators to getting people with disabilities better prepared for disasters.

Furthermore, social vulnerability describes how both individual and community characteristics can increase vulnerability to disasters. However, few studies examine how these multilevel factors interact. For instance, it could be hypothesized that individuals with disabilities living in low resource settings experience higher risk of vulnerability, which might in turn influence how they prepare for disasters. Nested models that account for multilevel structures of vulnerability can therefore further elucidate what factors contribute to preparedness among people with disabilities.

Chapter 3. Theoretical and Conceptual Frameworks

The specific relationships between the variables I am studying were largely guided by the existing empirical research as well as gaps in the literature concerning the pathways that elaborate my focal relationship of disability and disaster preparedness.[154] Nevertheless, my conceptual model and hypotheses were informed by important theories and frameworks that focus on disability, emergency preparedness, social cognitive influences of behavior change, and vulnerability to disasters. To start, I used the World Health Organization's (WHO) International Classification of Functioning, Disability and Health[22] to inform my operational definition of disability. Second, I adopted Chandra et al.'s community resilience framework[76] to frame my disaster preparedness outcome. Third, my key mediators, self-efficacy and response efficacy, were based on Rogers' coping appraisal construct of the Protection Motivation Theory.[155] When assessing how neighborhood social networks influence disaster preparedness, I was informed by James Coleman's Theory of Social Capital.[145] Finally, I used the expanded definition of social vulnerability that was developed by Susan Cutter and colleagues to frame my community-level measures of vulnerability and advantage.[13]

**International Classification of Functioning, Disability and Health**

The WHO's International Classification of Functioning, Disability and Health (ICF)[22] provides a common language and framework for describing disability and functional status. Unlike traditional health indicators of morbidity and mortality that have been seen as distinct from disability, ICF conceptualizes human functioning as a synthesis of biological, psychological, social, and environmental aspects of health.[156] The ICF taxonomy classifies health and health related states into two parts, each made up of different components. The first part consists of functioning and disability and is comprised of both body functions and structures, as

well as activities and participation. The second part describes contextual factors that can influence functioning and disability and is made up of environmental and personal factors.[22]

Within the ICF's functioning and disability domain, the body function component describes the physiological functions of body systems, such as mental, metabolic, and sensory functions.[22] Body structures, on the other hand, are the anatomical parts of the body that contribute to body systems and include organs and limbs. According to ICF, both body functions and structures can experience significant deviation or loss, also referred to as an *impairment*.[22] For instance, a decline in hearing or a loss of limb can both be classified as functional impairments.

An activity refers to "the execution of a task or action by an individual."[22] Activities include common tasks of daily functioning, such as those that relate to self-care, mobility, and learning and applying knowledge.[22] Individuals may experience difficulties in executing these activities, also known as *activity limitations*. Participation is the involvement in life situations, such as domestic, community, and social life, as well as other major life areas. *Participation restrictions* are problems that people can experience during the involvement in life situations.[22] For example, someone with a severe health condition may have difficulty participating in employment due to physical and/or social barriers.

The second part of the ICF classification covers the environmental and personal factors that can influence aspects of functioning and disability. Environmental factors consist of the physical, social and attitudinal environment in which people live. These external factors can positively or negatively influence an individual's performance and capacity to engage in life situations and activities, as well as the individual's body functioning or structure.[22] Personal factors are an individual's personal attributes that are not part of a health condition or health

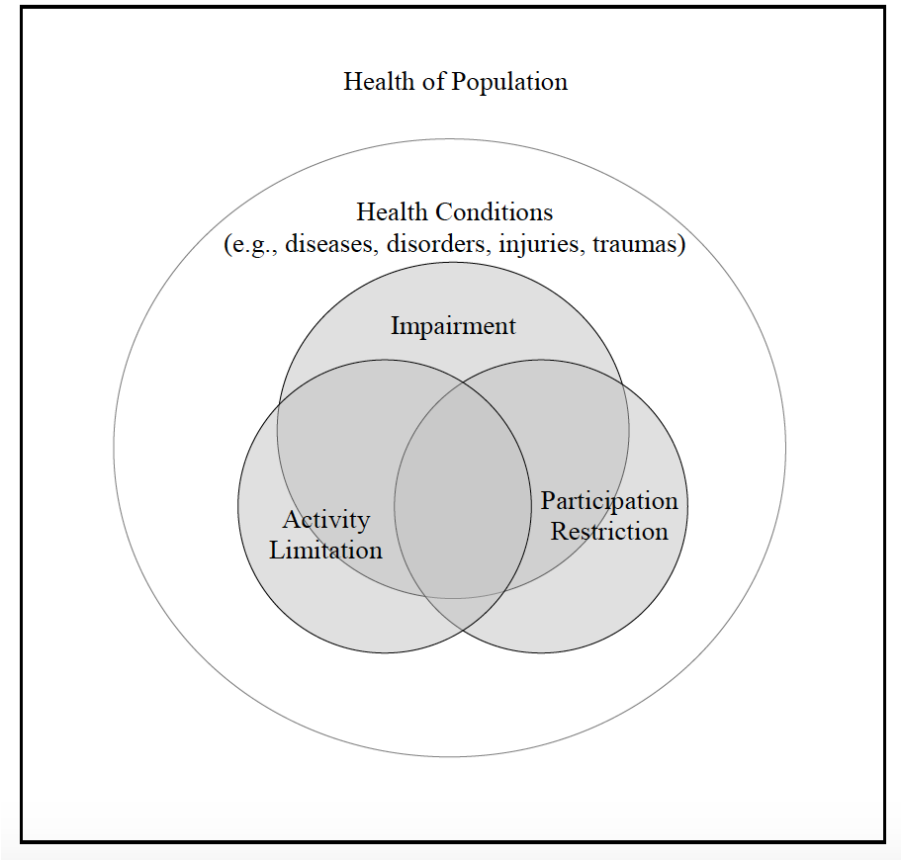
state, but may influence other aspects of disability status. These factors include demographic characteristics, health behaviors, past experiences, and other personal predispositions to disability and functioning.[22]

As my dissertation involves the operationalization of the disability construct, I focused on the first part of the ICF, which describes the different components of individual functioning and disability. The ICF conceptualizes disability as the presence of a bodily impairment, an activity limitation, or a restriction in participation in life situations.[22,157] These different factors can occur independently from each other but may also overlap, contributing to a multidimensional measure that exists on as a continuum of human functioning. For instance, one can possess a physical disability, which may or may not also interfere with activities of daily functioning.

Using the components of the ICF framework, Erickson and Dumoulin-Smith present a conceptual model of disability that demonstrates the multidimensionality and overlap of disability components (Figure 3.1). Within this model, a prerequisite to each ICF component of disability is the presence of a health condition, which includes diseases, injuries, health disorders, and other health related conditions.[157] Guided by the ICF framework and this conceptual model, I operationalized disability as a multidimensional measure of functional status by using four separate measures of health and disability that were previously included in the PHRETS dataset. These measures include variables of self-rated health, presence of activity limitations, dependence on medical equipment, and considering yourself to be a person with a disability. While I recognize that there may be overlap in these disability measures, I treated these measures separately in order to tease out the nuanced meanings of what it is like to possess varying degrees of disability. For instance, I anticipated that a larger proportion of my study sample would rate their health as poor or fair or indicate that they experience activity limitations,

but a smaller, more medically dependent segment of the population would require the use of special medical equipment. The inclusion of a measure that asks about whether the respondents consider themselves a person with a disability also allowed me to examine how perceptions of being disabled may differ from broader measures of functional limitations. To further understand how each of these measure differ from each other, I additionally examined the overlap between each of the disability measures as well as with other demographic characteristics.

**Figure 3.1** Disability Conceptual Model[157]




**Community Resilience Framework**

Community resilience— a community's sustained ability to bounce back from disasters—is a central framework guiding disaster preparedness and planning efforts in the U.S. and internationally. Unlike traditional preparedness methods, which have primary focused on

getting individuals and households self-sufficient in a disaster, a community resilience framework additionally emphasizes that people should work together to build a community's capacity to prepare for and respond to disasters.[144,158] To provide a roadmap for public health and emergency management agencies to design programs that build and strengthen community resilience, Chandra and colleagues developed a framework that outlines core components and levers that can be operationalized into specific activities and outcomes.[76] This framework was used to develop a community-wide disaster resilience building program that was implemented in Los Angeles County in 2014, as well as the survey instrument I used to measure participation in different household and community preparedness behaviors.[83]

Chandra et al.'s community resilience framework (Figure 3.2) is comprised of five core components and eight levers that were identified and validated for content through a literature review, stakeholder focus groups, and meetings with subject matter experts.[76] The core components of community resilience represent the broad, overarching factors that affect both "a community's pre-event vulnerability to disaster and its adaptive capacity to recover."[76] These components include the social and economic well-being of the community; physical and psychological health of the population; effective risk communication to reach different populations; level of social integration of government and nongovernmental organizations in disaster planning, response, and recovery; and the social connectedness of community members.[76] The levers consist of the means of reaching these components and can be used to identify different categories of disaster program strategies and activities.

The eight levers of community resilience are the following: wellness, access, education, engagement, self-sufficiency, partnership, quality, and efficiency. Wellness refers to pre- and post-disaster population health. Communities that are already healthy in terms of physical,

behavioral and social well-being (e.g., have a lower prevalence of disabilities) are better equipped to withstand the trauma of a disaster. When individual community members do not practice healthy lifestyles or if the community is not aware of its member's health-related functional needs, it becomes more difficult to quickly respond to and recover from a disaster. Activities that improve wellness, such as conducting assessment of community health needs or developing public health messaging to promote a healthy lifestyle, can therefore enhance community resilience to disasters.[76]

The access lever represents community and individual ability to seek quality health care and social services. When communities are made up of low-income or other vulnerable populations, inadequate access to health resources and services contributes to slow recovery after a disaster. Ways to improve access include identifying existing community assets that can support preparedness, response and recovery, providing psychological first aid after a disaster, and ensuring continuity of care for those requiring long-term health services post-disaster.[76]

Education is the public's availability to information about preparedness, hazard risks, and resources during the various stages of a disaster. Through public health education, the community can gain knowledge about roles, responsibilities, and expectations for individual and collective approaches to preparedness, response, and recovery. Education involves the dissemination of risk communication messages through media channels, such as public health campaigns, community trainings, and social media. During non-emergency periods, community education activities should also aim to enhance basic health literacy skills and awareness of health issues.[76]

Engagement refers to the promotion of community involvement in planning, response and recovery activities. Communities are more resilient against disasters when its members are

engaged in disaster planning, which can empower them to protect the health of their family and fellow community members. Community engagement involves promoting participatory decision-making in disaster preparedness and response through a number of activities, including joining voluntary response agencies, such as CERT, developing individual and community emergency plans, and building connections among community organizations and local social networks.[76]

Self-sufficiency represents the community members' abilities and resources to prepare for themselves in order to be self-reliant during an emergency. To build self-sufficiency, individuals should engage in personal or household preparedness as well as support the preparedness efforts of other community members. Public health agencies can promote the self-sufficiency of individuals and communities by promoting the development of household plans, emphasizing the role of citizens as first responders, encouraging civic responsibility, and educating the public so they have sufficient knowledge, skills and resources to be able to respond to a disaster.

The partnership lever encompasses the collaborations within and between government and nongovernmental organizations. By fostering partnerships across government and community-based organizations, communities can increase both the volume and diversity of available resources, such as personnel, land resources, or other forms of in-kind assets. Examples of activities that support partnerships are the development of planning committees between public and private sectors, the identification of strategies to build the capacity of NGOs as partners in health security, and the assessment of existing networks and social routines among community members and organizations to identify strategies to activate them during a disaster. [76]

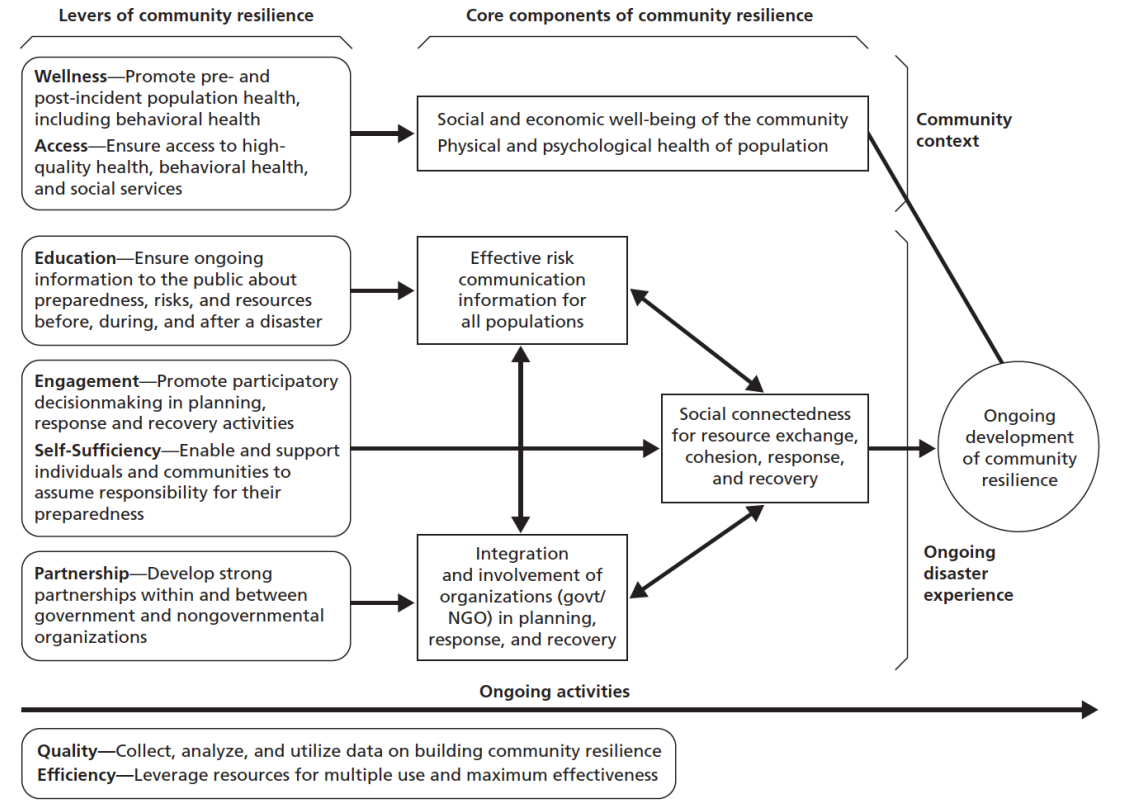
Quality is the use of data and information for evaluation, monitoring, and decision-making to build community resilience. Once activities related to wellness, access, education,

engagement, self-sufficiency, and partnership are implemented, it is essential to monitor and evaluate progress in order to establish best practices and ensure continuous quality improvement. Activities associated with this lever include monitoring continuity/quality of care and long-term health effects before, during, and after a disaster, regularly collecting data on community resilience measures for evaluation research, and utilizing and sharing these evaluation findings to improve community resilience-building efforts.[76]

Finally, efficiency assesses the ability to leverage resources that maximize use and effectiveness. In a resource-limited environment, we must be able to leverage existing resources to be able to effectively implement activities associated with the other community resilience levers. Greater efficiency is also needed for processes that aim to improve disaster recovery, as significant human and financial costs can result from gaps in services or unnecessary redundancies. Efficiency requires the use of advanced planning for emergency efforts, such as budget guidance for the transition from response to recovery, as well as monitoring systems that determine where resources should be allocated to address community needs.[76]

Together the eight levers of community resilience provide a roadmap for planning comprehensive programs that can help communities become more resilient to disasters. A diagram of the entire framework can be found in Figure 2.

**Figure 3.2** Community Resilience Framework[76]




My disaster preparedness outcome, which focuses on individual participation preparedness behaviors that contribute to community disaster resilience, was guided by two of the levers of Chandra et al.'s community resilience framework: self-sufficiency and engagement. The self-sufficiency lever was operationalized into several household or personal preparedness actions that could help individuals and families protect their health and wellbeing in the days following a disaster. These types of behaviors included possessing disaster supplies, such as a 3-day supply of water and non-perishable food, and developing a disaster communication plan among members of the household. The engagement lever was operationalized into the community-oriented actions that help entire communities work together to build disaster resilience. These measures involved participating in several community disaster planning and response behaviors, including attending community meetings to discuss disaster plans and

participating in emergency response trainings related to CPR and psychological first aid. Chandra et al. propose that the behaviors in these two levers contribute to social connectedness among community members in order to exchange resources and develop a cohesive community. This in turn promotes community capacity to respond to and recover from a disaster, contributing to its ongoing development of community resilience. Guided by this framework, I used a preparedness outcome measure that captures the multiple dimensions of building community resilience.

**Protection Motivation Theory**

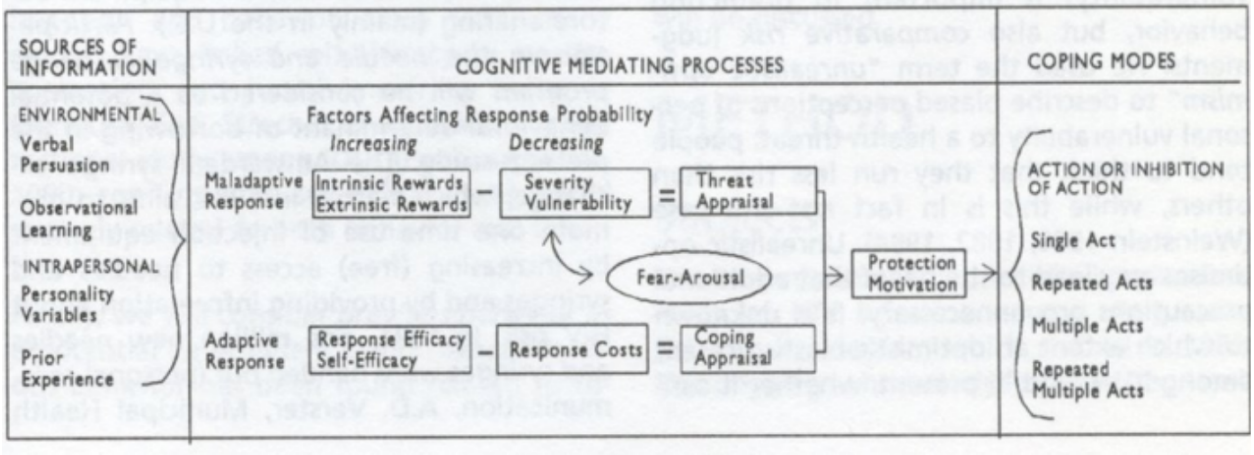
Like with most health promotion behaviors, engaging in disaster preparedness actions depends on one's personal beliefs and cognitions, as well as their interactions with their environment. There are a number of behavior theories that have been used to study social cognitive variables within the context of disaster preparedness. One theory that has been used to predict preparedness across a variety of hazards is Rogers' Protection Motivation Theory (PMT).[116] PMT was developed based on prior research of fear appraisal and how cognitive evaluation of threat and protective behaviors affect changes in attitudes and intentions.[155] PMT posits that there are two appraisal processes, threat appraisal and coping appraisal. Threat appraisal predominantly motivates healthful behaviors through the influence of perceived severity and perceived susceptibility of a health threat, also often referred to as risk perception. Rogers proposed that beliefs about a threat being neither serious nor very likely to occur can result in an increased probability of engaging in maladaptive practices. For instance, if one thinks that lung cancer is neither a severe disease nor likely to result from smoking cigarettes, then they would be more likely to smoke. In addition to risk perception, rewards for engaging in a

maladaptive behavior can also increase the likelihood of this behavioral response. Influential behavioral rewards can be either intrinsic (e.g. reduced stress) or extrinsic (social acceptance).

Coping appraisal, on the other hand, deals with adaptive practices that positively protect health. These behaviors are primarily determined by measures of self-efficacy and response efficacy.[155] Using the smoking example, an adaptive response would be to try to quit smoking to reduce the negative health consequences. One would be more likely to quit smoking if he/she both believed they could successfully quit (self-efficacy) and that quitting is an effective way to avoid smoking health risks (response efficacy). In addition to measures of efficacy, the costs associated with this adaptive behavior, such as inconvenience or expense, can also influence whether or not they actually engage in the behavior. Higher response costs would ultimately reduce coping appraisal.[155]

Protection motivation is best conceived as a measure of the intentions to engage in behaviors that can protect oneself from hazards. Figure 3 demonstrates how the additive threat appraisal and coping appraisal processes lead to protection motivation, which ultimately influences behavior. Precursors to the cognitive mediating processes are potential sources of information through environmental and intrapersonal factors, such as verbal persuasion, observational learning, personality factors, and prior experience.

**Figure 3.3** Protection Motivation Theory[155]




As the focus of my dissertation is on the adaptive practices of preparing for disasters, I utilized the coping appraisal portion of PMT to guide my analysis. More specifically, I examined how self-efficacy and response efficacy mediate the focal relationship between disability and disaster preparedness behaviors. I did not focus on the threat appraisal portion of the PMT model, as these variables were not available in the dataset that I am using. There is also inconsistent literature supporting the effect of perceived risk on preparedness behavior, suggesting that this variable might not be appropriate to study in the context of disaster preparedness.

In addition to the coping appraisal pathways, I am interested in how prior experience, one of PMT's precursor sources of information, moderates these cognitive mediating processes. The empirical literature suggests that personal experience with disasters may increase engagement in pre-disaster preparedness among people with disabilities. While the dataset I am using did not contain a specific variable that would allow be to study this relationship, there are publically available data of ongoing environmental risks to hazards, which can act as proxy measures to prior experience. In particular, wildfires represent a seasonal hazard in Los Angeles County that

is largely linked to geography. People living in high risk regions are more likely to be exposed to hazard information and evacuation orders, and may thus possess greater information about preparedness. To study this relationship, I therefore assessed whether living in a community with very high exposure to wildfire risk attenuates the negative relationship between disability status and preparedness.

**Social Capital**

According to James Coleman, social capital is a concept that captures how relationships among people provide resources that can facilitate action.[145] While there are several theorists who have conceptualized social capital in different ways, Coleman emphasizes that it is not a single entity, but rather defined by the function it provides.[145] Social capital can thus manifest in several ways as long as it relates to some aspect inherent in social structures and it facilitates actions among members of that social structure.[145]

Coleman differentiates between six forms of social capital based on the function it provides: obligations and expectations, informational potential, norms and effective sanctions, authority relations, appropriable social organizations, and intentional organizations.[159] Obligations and expectation refer to how social structures create a system in which actors are expected and obligated to reciprocate certain actions. This type of social capital largely depends on the trustworthiness of the environment (i.e. the likelihood of obligations being repaid) as well as the extent that members of the social system are obligated to each other.[145] Information potential is the ability to acquire information through social relations, which can provide a basis for action.[159] Norms and effective sanctions comprise the social norms that support or constrain actions.[145] Authority relations describe how a designated leader of a group can extend access and relations of the entire group.[146] Appropriable social organizations measure how organizations

that form for one purpose can then provide additional resources for other purposes once the initial purpose is addressed.[145] Finally, intentional organizations refer to how developing a social organization results in investment in different forms of social capital, which can both advance interests of those who invested in it or provide a public good to individuals who did not directly invest.[146]

Based on Coleman's Theory of Social Capital, social relationships can provide a variety of resources that can be applied to achieve different goals. One could therefore hypothesize that the more relationships one has within a social structure, the more potential for different social capital functions. This assumption could extend to a disaster preparedness context, where neighbors could provide the social capital needed to encourage others to participate in different preparedness behaviors. For example, social connections with neighbors may provide information potential to learn about the recommended disaster preparedness actions either passively or through active milling. Another example might be that attending community meetings where preparedness plans are discussed is part of the norms established by members of a community. In each of these scenarios, a larger neighborhood network size could lead to more opportunities to engage in disaster preparedness (and vice versa), suggesting the potential for social capital to moderate this outcome. I was thus informed by James Coleman's Theory of Social Capital when hypothesizing how neighborhood social networks influence disaster preparedness.

**Social Vulnerability**

The major social factors that contribute to health disparities are well studied across the social science literature. Socioeconomic status, gender, race/ethnicity, and age are some of the key examples of characteristics that contribute to differentials in power and access to resources,

exposing certain groups to greater health risks than others. These same factors contribute to a social group's vulnerability to disasters by influencing both their susceptibility to disaster harm and their ability to respond to and recover from a disaster.[13] Social inequities make it more difficult for certain social groups to protect against the impact of disasters before, during and after it occurs.

In addition to these social factors, Cutter et al. suggest that we must also consider how social factors interact with the local environment or place.[13] The built environment, such as economic and housing conditions, contribute to the social vulnerability of places in which people reside. For example, the physical structure and density of buildings can put certain environments at greater risk for economic losses, injuries, and fatalities that can result from hazards. An expanded definition of social vulnerability thus takes into account the socioeconomic characteristics of communities as well as the physical environment that can potentially compound the consequences of disasters.

The multidimensional conceptualization of social vulnerability is what inspired the development of the social vulnerability index that I used to study community-level social vulnerability.[18] Developed through a collaboration between the CDC's National Office of Terrorism Preparedness and Emergency (OTPER) and the Agency for Toxic Substances and Disease Registry's Geospatial Research, Analysis, and Services Program, this index was designed to assist OTPER-funded state partners in disaster preparedness, response, recovery and mitigation.[18] The dimensions that comprise this index include variables related to socioeconomic status, household composition, minority status and language, and housing and transportation. These domains build on empirical research that examines vulnerability as a social condition or measure of the resilience of social groups when confronted by disaster.[13,18] The socioeconomic

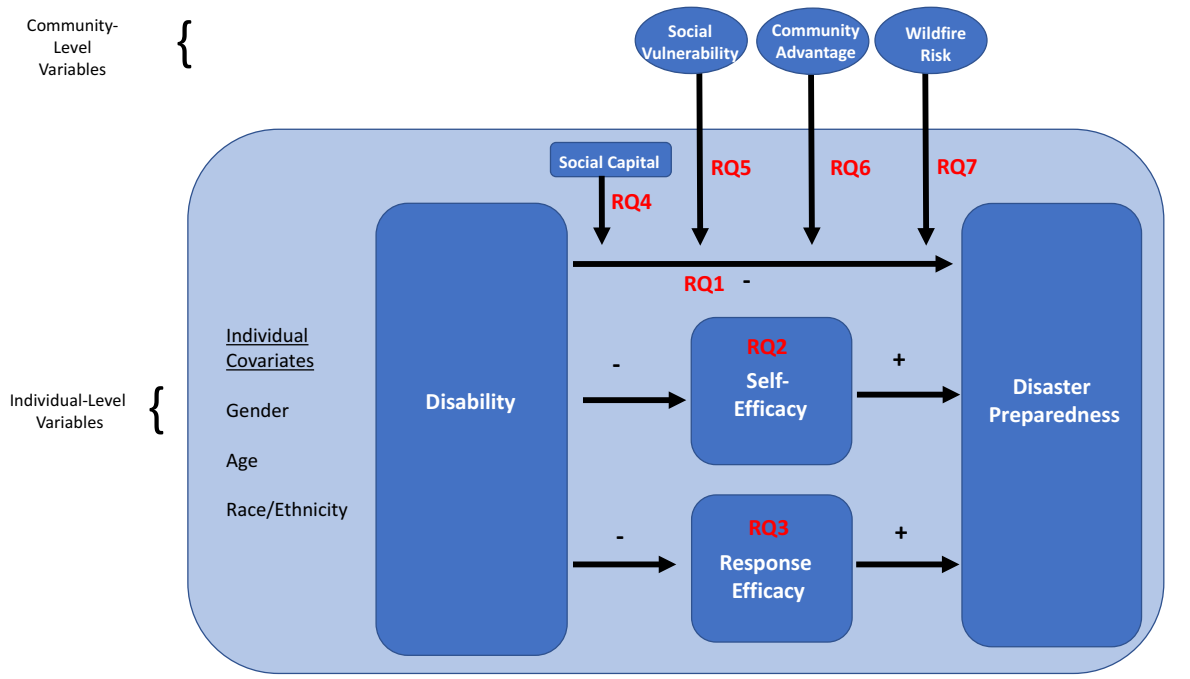
vulnerability domain is made up of indicators of per capita income, poverty, unemployment, and high school dropout rates. Household composition vulnerability includes measures of households with elderly persons, children, and single parents. Minority status and language vulnerability measures the percentage of people who belong to minority groups and who lack English proficiency.[160] Housing and transportation vulnerability includes estimates of within and between household crowding, lack of access to a vehicle, presence of mobile homes, and proportion of persons in institutionalized groups quarters.[160] A composite social vulnerability index exists as a combination of each of these domains and thus represents the multidimensional construct of overall social vulnerability. I used both SVI's domain and composite scores to study how social vulnerability of communities influences individual-level disaster preparedness among people with disabilities.

In addition to SVI, I also used the Healthy Places Index (HPI) to assess how community-level advantage influences preparedness. HPI focuses on the social determinants of health and thus also contains social indicators of vulnerability, such as measures of economic advantage, neighborhood conditions, and housing density. HPI recognizes that health is produced by social factors not addressed by the health care system or individual-level factors.[161] While not specifically developed within the context of disasters, it assumes a holistic view of health that is consistent with a social vulnerability perspective and is linked to the notion of the social and built environment role in population health. Other indicators in this index include measures of environmental cleanliness, voter participation, and access to resources needed to engage in health promoting behaviors, such as parks and grocery stores (a complete description of measure to be found in methods section).

**Conceptual Model**

Figure 3 presents my dissertation's conceptual model. At the individual level, my two focal variables are disability and disaster preparedness. The additional variables that explain and influence my focal relationship are described in the research questions and hypotheses that follow. The hypotheses associated with each research question (RQ1-RQ7) are labeled on the conceptual model in red.

**Figure 3.4** Multilevel Conceptual Model to Test Dissertation Hypotheses




**Research Question #1 (RQ1)**: How does living with disabilities influence participation in disaster preparedness behaviors in comparison to the general population?

**RQ1 Hypothesis:**

**H1.1** There is an inverse relationship between disability status and disaster preparedness so that people living with disabilities participate in fewer disaster preparedness behaviors in comparison to those who do not have disabilities.

**Research Question #2 (RQ2)**: How does self-efficacy influence participation in disaster preparedness behaviors among people with disabilities?

**RQ2 Hypotheses:**

**H2.1** There is an inverse relationship between disability status and self-efficacy so that people living with disabilities have lower self-efficacy for disaster preparedness in comparison to those who do not have disabilities.

**H2.2** There is direct relationship between self-efficacy and disaster preparedness so that self-efficacy is positively associated with participation in disaster preparedness behaviors.

**H2.3** Self-efficacy for preparing for disasters partially mediates the relationship between living with disabilities and participation in disaster preparedness behaviors, with one's disability status associated with lower self-efficacy, a positive correlate of preparedness.

**Research Question #3 (RQ3)**: How does response efficacy influence participation in disaster preparedness behaviors among people with disabilities?

**RQ3 Hypotheses:**

**H3.1** There is an inverse relationship between disability status and response efficacy so that people living with disabilities have lower response efficacy for disaster preparedness in comparison to those who do not have disabilities.

**H3.2** There is direct relationship between response efficacy and disaster preparedness so that response efficacy for disaster preparedness is positively associated with participation in disaster preparedness behaviors.

**H3.3** Response efficacy for preparing for disasters partially mediates the relationship between living with disabilities and participation in disaster preparedness behaviors, with disability status associated with lower response efficacy, a positive correlate of preparedness.

**Research Question #4 (RQ4)**: How does neighborhood social capital moderate participation in disaster preparedness behaviors among people with disabilities?

**RQ4 Hypothesis:**

**H4.1** Neighborhood social capital moderates the association between disability status and disaster preparedness so that when social capital is high, the negative relationship between disabilities and preparedness is weaker; conversely, when social capital is low the negative relationship between disabilities and preparedness is stronger.

**Research Question #5 (RQ5):** How does community-level social vulnerability, as measured using the Social Vulnerability Index's composite and domain-specific vulnerability rankings (see description of measures in methods), moderate participation in disaster preparedness behaviors among people with disabilities?

**RQ5 Hypothesis:**

**H5.1** Social vulnerability moderates the association between disability status and disaster preparedness so that when social vulnerability is high, the negative relationship between disabilities and preparedness is stronger; conversely, when vulnerability is low, the negative relationship between disabilities and preparedness is weaker.

**Research Question #6 (RQ6):** How does community advantage, as measured using the Healthy Places Index composite and domain-specific advantage rankings (see description of measures in methods), moderate participation in disaster preparedness behaviors among people with disabilities?

**RQ6 Hypothesis:**

**H6.1** Community advantage moderates the association between disability status and disaster preparedness so that when advantage is high, the negative relationship between disabilities and preparedness is weaker; conversely, when advantage is low, the negative relationship between disabilities and preparedness is stronger.

**Research Question #7 (RQ7):** How does wildfire risk, as measures as the percentage of population living in very high wildfire risk area in each community, moderate participation in disaster preparedness behaviors among people with disabilities?

**RQ7 Hypothesis:**

**H7.1** Wildfire risk moderates the association between disability status and disaster preparedness so that when risk is high, the negative relationship between disabilities and preparedness is weaker; conversely, when risk is low, the negative relationship between disabilities and preparedness is stronger.

Chapter 4. Research Design and Methodology

## Study Sample and Data Collection

### *Public Health Response to Emergent Threats Survey*

I used data from the 2013 Public Health Response to Emergent Threats Survey (PHRETS), a household-level survey fielded by the Los Angeles County Department of Public Health Emergency Preparedness and Response Program. The PHRETS survey is periodically conducted in Los Angeles County to guide and evaluate local disaster planning efforts. The 2013 survey was specifically designed to collect baseline data as part of the mixed methods evaluation strategy for the Los Angeles Community Disaster Resilience Project (LACCDR). LACCDR was a community-based program that involved the implementation of a community resilience toolkit equipped with training resources and technical assistance to specific communities. However, because I used baseline data prior to the implementation of any experimental conditions, I treated the data as a cross-sectional assessment of the population within the 16 communities included in program, 8 of which were in a 'treatment' conditions and 8 of which were in a 'control' condition.

I chose this survey to test my hypotheses, as it possesses a number of important variables that have been shown to be associated with disaster preparedness behaviors, including the different measures included in my conceptual model. It contains data on disaster preparedness behaviors at both the household and community level, four different measures of perceived health and disability status, key indicators for my mediating and moderating variables of interest (self-efficacy, response efficacy, social capital), and important socio-demographic characteristics. The greater Los Angeles region is also a critical setting for studying disaster preparedness. It is the second largest urban area in the U.S. and is ranked as the top city in North

and South America for the number of people potentially affected by a natural disaster due to heightened risks for earthquakes, wildfires, landslides, flooding, and tsunamis.[70,162]

The survey measures data at the individual level, as individuals over the age of 18 were invited to participate in the survey from select households. Each of these households was clustered into a one of sixteen distinct communities in Los Angeles County. The respondents (n=4700) were adult residents (≥18 years old) of the sixteen communities chosen based on five criteria for defining distinct and cohesive communities. Two communities were chosen from each of the eight Los Angeles County Service Planning Areas (SPAs). SPAs are geographical regions that allow the Department of Public Health to target specific health needs of the residents in these areas in order to deliver more relevant public health services.[163] The communities were chosen using the following criteria: (1) Modest-size population (30,000-40,000 persons living in neighborhood/community); (2) Shared identity as a "community" with at least two of the following: local business community, school/school district, police and fire department services, community clinic/hospital/health responsible entity, or evidence of engaged community-based organizations or civic leaders; (3) An existing local neighborhood coalition or planning group; (4) At least 30% of population belonging to under-resourced groups, such as racial/ethnic minorities and low-income individuals; and 5) diversity disaster risk exposure, such as level and type of disaster (earthquake, flood, or wildfire). The following communities were sampled: Acton/Agua Dulce (n=235), Compton (n=350), Culver City (n=350), Gardena (n=350), Hawaiian Gardens (n=158), Hollywood (n=350), Huntington Park (n=274), La Crescenta (n=350), Palms (n=288), Pico Union (n=256), Pomona (n=336), Quartz Hill (n=336), San Fernando (n=275), San Gabriel (n=265), Watts (n=268), and Wilmington (n=259).

Address-based sampling, which sampled addresses from a listing of all residential mail delivery locations in the U.S., was using to identify the sample. The sampling frame is a list of addresses in the census tracts in each of the 16 communities, which was available through the Computerized Delivery Sequence File developed and maintained by the U.S. Postal Service. In instances where there were overlapping census tracts across the selected communities, the census tract was not included in the sampling. The sampling unit was the address. Households were chosen using computer-generated random sampling. For this survey, eligible respondents were adults 18 years old or older who resided in the sampled residence for more than half the time over the two weeks prior to receiving the interview. The goal was to complete 300 interviews in each of the sixteen communities in order to reach a targeted total sample of 4,800 interviews.

The cross-sectional PHRETS survey was collected via landline and mobile telephone in English, Spanish or Korean between June 3 and August 7, 2013. Sample release was staggered across 12 replicates that were randomly assembled clusters of sample. Replicates 1 through 5 were released on June 3, 2013. Replicates 6 through 10 were released on June 26, 2013. Replicate 11 was released on July 16, 2013. Lastly, replicate 12 was released on July 26, 2013.

The Los Angeles County Department of Public Health hired Abt Survey Sampling and Methodology Division and Abt SRBI, Inc, an independent market research and public opinion firm that provides services to large and medium-sized business, advertising firms, and government agencies, to collect the data. Trained interviewers from Abt SRBI conducted telephone interviews using a computer-assisted telephone interviewing system. Abt SRBI attempted to survey an eligible respondent from each of the households where a telephone number could be matched to the sampled address. When addresses did not have a telephone associated with the address, which occurred in 50% or more of the sample households, a letter

was sent to the address that described the purpose of the survey and encouraged respondents to call a toll-free number to complete the interview. When respondent contacted the Abt SRBI via the toll-free number, the agency confirmed eligibility and proceeded with the telephone interview.

Due to low response rates using both the telephone matched and mail-in sampling methods, the sampling method was modified after three weeks of recruitment. The surveying agency determined that the mail-in method was slower and less efficient, so for the remainder of the sampling, the matched telephone addresses were exclusively used. Additional address-based telephone numbers were fielded to complete the total sample used in this study.

The total number of completed interviews within the sixteen communities ranged from 235 to 350, with one exception (Hawaiian Gardens) having only 158 completed interviews. Statistical weighting techniques, which will be described later, were used to enhance the representativeness of the sample based on the gender, age and race/ethnicity benchmarks specified by the sampling design.

The study protocol was reviewed and approved by the institutional review board of the Los Angeles County Department of Public Health prior to data collection. The overall response rate for the survey interviews was 35%.

*Social Vulnerability Index*

I additionally used the 2010 Social Vulnerability Index (SVI) as second source of data for my analysis.[18] The SVI was created by Flanagan and colleagues in 2011 to study social factors that contribute to disaster vulnerability in order to improve disaster management at the various phases of the disaster cycle.[18] SVI is comprised of 14 indicators that can be grouped into four domains of social vulnerability: socioeconomic status, household composition, minority

status/language, and housing/transportation.[160] The CDC's Agency for Toxic Substances and Disease Registry currently publishes SVI percentile ranks for each indicator, domain, and a composite SVI score, which are all publically available on the CDC's website. These data exist at the census tract level, providing me with the opportunity to study social vulnerability of the 16 Los Angeles County communities that were sampled by PHRETS. By using both the PHRETS and SVI datasets, I assessed how community-level social vulnerability influences individual-level preparedness among people living with disabilities.

The 2010 SVI is comprised of 100% count data from the 2010 U.S. Census for the following five SVI indicators: persons aged 65 and older, persons aged 17 and younger, single parent households, minority status (all groups except white, non-Hispanic), and persons living in Group Quarters.[160] The remaining nine indicators come from 2006-2010 American Community Survey (ACS) and include 5-year estimates for the following indicators: persons below the poverty level, civilian unemployed, per capita income, high school diploma for persons aged 25 and older, persons who speak English less than well, housing units with 10 or more units in structure, more people than bedrooms in household, mobile homes, and no vehicle access.[160]

Measures collected from the decennial Census and ACS variables are intended to be representative of the entire U.S. population, including those living in the Los Angeles County census tracts that I will be studying. The U.S. Census counts every member of the U.S. population every ten years. The U.S. Census Bureau collects ACS data every year from a representative sample of U.S. household to generate population estimates. It uses ongoing measurement methods and a series of monthly samples to produce annual estimates for the same census tracts and block groups that are surveyed during the decennial Census. ACS samples individuals from housing units (HU) and residents of group quarters (GQ), which are derived

from the Census Bureau's Master Address File.[164] An HU is "a house, an apartment, a mobile home, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters.[164]" GQs, which were added to address sample since 2006, are "places where people live or stay, in a group living arrangement that is owned or managed by an entity or organization providing housing and/or services for the residents."[164] Examples of GQ facilities include college/university student housing, skilled nursing facilities, group homes, and correctional facilities.[164]

In 2010, the U.S. Census Bureau collected data from 308,745,538 people and 131,704,730 households residing the 50 U.S. states, Washington, DC, Puerto Rico, and the Island Areas.[165] The ten-item questionnaire was made available in 59 different languages. Prior to mailing out Census surveys, a $133 million marketing and promotional campaign was launched to raise awareness about the Census, which included television, radio, print, outdoor, and internet advertising.[165] Data was collected via mail-in survey, with 130,000 households additionally using the toll-free telephone assistance to complete the survey.[165] To follow up with households that either neglected to mail back their form or did not receive one, enumerators also went door-to-door to collect additional census data. The final Census mail response rate was 74%, meaning that 74% of all households and group quarters filled out and mailed back their 2010 Census questionnaire.[165]

ACS generates annual estimates of census tracts using data collected from a series of monthly samples. Data is collected from Household Units and Group Quarters samples throughout the United States as well as Puerto Rico. ACS collects HU data via internet, mail, telephone, and personal visit. Print materials are written in English, but respondents can also request Spanish materials via telephone questionnaire assistance.[164] Typically, respondents are

first mailed a request to respond via the internet, followed by the option to fill out and return a paper questionnaire by mail. To receive the mail package, sample addresses require sufficient information for mailing in the U.S. After the pre-notice and initial mail packages are sent, up to three other reminders are sent to encourage respondents to complete the online or paper questionnaire.[164] If the respondent does not respond to either of these methods, the Census Bureau then follows up with computer-assisted telephone interviewing (CATI). The automated CATI instrument is available in both English and Spanish and only requires that the sample address respondent possess a working telephone number. If no telephone number is available or the respondent refuses, the sample address may be selected for a computer-assisted personal interviewing (CAPI). Census Bureau field representatives out of six regional offices are responsible for delivering the CAPI using an automated survey instrument loaded onto a laptop PC that is available in English and Spanish.[164] The field representative first attempts to conduct the interviews by telephone but if they cannot reach the resident after calling several times, they will make a personal visit.[164]

The ACS GQ sample consists of 12 independent samples, with a new sample introduced each month. The data collection lasts six weeks for each monthly sample and does not include additional nonresponse follow-up.[164] The Census Bureau field representatives first interviews the sample GQ facility contact person to verify the type of facility before randomly drawing a sample of residents to interview. They use the automated Group Quarters Facility Questionnaire to conduct this assessment and the field representative then interviews a sample of facility residents individually using an automated CAPI instrument.[164] If unable to complete a CAPI interview, they may also distribute a self-response questionnaire available in English and Spanish.[164]

*Healthy Places Index*

In addition to PHRETS and SVI, I also used data from the Healthy Places Index (HPI). Developed by the Public Health Alliance of Southern California in collaboration with Virginia Commonwealth University, HPI provides a metric for community-level opportunities for health improvement.[161] HPI contains 25 indicators related to social determinants of health and community resilience that can be organized into the following eight policy action domains: economy, education, healthcare access, housing, neighborhoods, clean environment, transportation, and social environment.[161] Like with SVI, percentile ranks are made publically available for each indicator, domain, as well as a composite HPI score. These data exist at the census tract level, lending itself to further multilevel analysis of how community-level advantage influences individual-level preparedness among people with disabilities.

Indicators included in HPI come from different publically available data sources published by government institutions, non-profits, and universities, including the U.S. Census Bureau, the California Environmental Protection Agency (CalEPA), Green Info, the National Land Cover Database, the U.S. Department of Food and Agriculture, the U.S. Environmental Protection Agency, the U.S. Department of Housing and Urban Development (HUD), the Alcoholic Beverage Commission, and the University of California, Berkeley.[161] HPI includes measures at the census tract level for all California census tracts that meet the following two criteria: 1) there is a population of 1500 or greater in the 2010 decennial census and 2) the group quarters population is less than 50% of the total 2010 population. These eligibility criteria are meant to improve the statistical validity and reliability of the index.[161]

The following HPI indicators are taken from the U.S. Census Bureau's 5-year ACS estimates (2011-2015): percent of population above 200% federal poverty level; percent of

population aged 25-64 who are employed; median household income; percent of population over age 25 with a bachelor's education or higher; percent of 15-17 year olds enrolled in school; percent of 3 and 4 year olds enrolled in pre-school; percent of adults aged 18 to 64 years currently insured; percent of occupied housing units occupied by property owners; percent of households with complete kitchen facilities and plumbing; percent of households with less than or equal to 1 occupant per room; percent of family households with children under 18 with two parents; percent of households with access to an automobile; and percent of workers (16 years and older) commuting by walking, cycling, or transit.[161] As previously described for the SVI indicators, ACS data is collected from representative samples of U.S. census tracts using a series of monthly samples from Household Units and Group Quarters throughout the U.S. and Puerto Rico. These data are collected through several techniques including the internet, mail, CATI and CAPI (full description available for SVI data).

Four indicators that relate to the cleanliness of the environment come from measures published by CalEPA. These indicators include diesel PM emissions; the average maximum 8-hour summer ozone concentration in parts per million (2012-2014); the average concentration for PM2.5 (2012-2014); and mean drinking water contaminant index for selected contaminants (2013-2015). Diesel emission data is collected by the California Air Resources Board, which produces grid-based emission estimates on a 4km by 4km statewide Cartesian grid system. Diesel PM emissions from on- and off-road sources were extracted for a July 2012 weekday from the grid-based emissions.[166] Data on ozone and PM2.5 concentrations are regularly collected by the CalEPA's Air Resources Board and local agencies as a part of California's ambient air monitoring network. These agencies measure ambient outdoor concentrations of pollutants at more than 4000 monitoring stations and send hourly or daily measurements of

pollutant concentrations to the CalEPA's database.[167] Drinking water quality is measured by the CalEnvironScreen, which takes samples nearly 3000 water systems throughout the state and tests for 10 individual chemical contaminants and two water quality violations.[168] Using this data, CalEnvironScreen calculates a cumulative contaminant percentile score for each census tract.[168]

Two of HPI's housing indicators come from HUD's Comprehensive Housing Assessment System. These measures include the percent of low income homeowners paying more than 50% of income on housing cost and the percent of low income renter households paying more than 50% of income on housing costs. These measure consists of custom tabulations of data that were originally collected by the U.S. Census Bureau's ACS, but that are not otherwise publicly available.[169] HUD publishes these data in tabular form on their website.

GreenInfo provides data for the HPI park access indicator, which is measured as the percentage of the population living within 0.5-mile of a park, beach, or open space greater than 1 acre. GreenInfo developed maps of existing park availability by census tract using GIS mapping tools, census population data, and data on existing park/green spaces from the California Protected Areas Database.[170]

HPI includes an indicator for tree canopy in its neighborhood domain that is measured as population-weighted percentage of the census tract area with tree canopy. This indicator comes from the 2011 National Land Cover Database (NLCD), which models nation-wide percent tree canopy cover using photographic interpretation of National Agriculture Imagery Program (NAIP) aerial imagery, Landsat 5 imagery, ancillary data such as elevation, and previous NLCD data.[171] Samples of approximately 65,000 locations were photo-interpreted for percent tree canopy cover using NAIP imagery.[171] Data is available in both an analytical version and

cartographic version. The analytical version was used to estimating average tree canopy cover by census tract.

HPI's supermarket access indicator assesses the percent of population living 0.5 miles from a supermarket/large grocery store in an urban area or small town, and 10 miles for those living in a rural area. These data are published by the U.S. Department of Agriculture Food Access Research Atlas, 2015. To generate these data, an entire county is first divided into 0.5km square grids. Estimates of the population from the 2010 Census are then allocated aerially to each of these grids.[172] Locations of grocery stores are determined using a list of stores authorized to accept SNAP benefits and a list of stores from a proprietary store directory.[172] These data are then used to calculate the distance to the nearest supermarket for each grid cell. Data on the estimated number of people in each cell that are either 1 mile in urban areas or 10 miles in rural areas are then aggregated to the census tract level. [172]

Another neighborhood HPI indicator is the percentage of the population residing within 0.25 miles of an off-site sales alcohol outlet, which is published by the California Department of Public Health. To generate this indicator, addresses of all establishments with active off-sale alcohol licenses were established using a raw data file published by California Department of Alcohol and Beverage Control in 2014.[173] These addresses were then imported into ArcMap and displayed as X, Y points, with 0.25 mile buffers around each point. Census blocks centroids were then added, for which to population estimates were available from the 2010 decennial Census.[173] The indicator was then calculated by dividing the number of people living within 0.25 miles of an outlet by the total number of people in each block.[173] These data were later aggregated to the census tract level.

An additional neighborhood HPI indictor measures employment density, which combines job density for retail, entertainment, and educational uses. Data for this indicator come from the U.S. Environmental Protection Agency's Smart Location Database from 2010. This database provides nationwide geographic data for more than 90 different attributes available at the census block, such as housing density, diversity of land use, employment, and demographics.[174] The employment density measure is derived from U.S. Census Bureau's Longitudinal Employer-Household Dynamics Program, which primarily gathers data from Unemployment Insurance earnings data and the Quarterly Census of Employment and Wages.[175] Employment density is then calculated by dividing the number of jobs for retail, entertainment, and educational uses by the acreage of unprotected land.[174]

The last HPI indicator measures voter participation as the percentage of registered voters voting in the 2012 general election. This measure comes from the University of California's Berkeley School of Law Center, which maintains a statewide database of Statements of Vote and the Statements of Registration for each statewide election since 1992.[176] Registration and voting data are collected by the County Registrar of Voters or County Clerks in each of California's 58 counties.[176]

In addition to the 25 HPI indicators, the Public Health Alliance of California also publishes 45 decision-support indicators that cover various health outcomes, behavioral risk factors, and environmental hazards and vulnerabilities. These data are available in tabular form as well as map layers at the census tract level. Among the available indicators is a measure of wildfire risk, which is presented as the percent of the population currently living in very high wildfire risk areas. This variable comes from California Department of Forestry and Fire Protection's (CAL FIRE) California Fire Hazard Severity Zone Map Update Project, which

ranks regions according to moderate, high and very high fire hazard. CAL FIRE determines geographical risk to wildfires based on the potential to cause ignitions to buildings based on fuels, terrain, and weather.[177]

**Instruments/Materials**

*Public Health Response to Emergency Threats Survey*

PHRETS is a household-level survey periodically fielded in Los Angeles County to guide and evaluate local disaster planning efforts. Due to the fact that the 2013 survey was used to collect baseline data as part of the mixed methods evaluation strategy of the LACCDR Project, the content of the survey contains outcome measures related to the experimental arm's toolkit activities, such as table-top exercises and community meetings, as well as household-level behaviors and attitudes related to community disaster resilience.[83]

Survey questions were drawn from published studies and planned national surveys, including the 2009 Citizen Corps National Survey, the Behavioral Risk Factor Surveillance System Questionnaire, and the 2008 Canadian General Social Survey. They were also guided by Chandra et al.'s community resilience framework.[76] The PHRETS survey measures several domains related to community resilience, including household preparedness for disasters; participation in community resilience building activities; self-efficacy for helping in a disaster; perceived collective efficacy of the community in a disaster; perceived benefits of disaster planning with neighbors; social networks available in a disaster; and civic engagement.

*Social Vulnerability Index*

The 14-item SVI contains measures from both the 2010 Census the American Community Survey (2006-2010). The 2010 Census contains data on 10 questions related to name, gender, age, race, ethnicity, relationship, and whether you own or rent your home.[165] ACS

collects data on information that was previously collected by the long form of the decennial Census. Measures include race/ethnicity, educational attainment, income, language proficiency, migration, disability, employment, and housing characteristics.[164] These measures can help track changes in population demographics, plan for emergencies, and learn about local communities. The data are publically available on the U.S. Census website.

Using these data sources, the CDC's Agency for Toxic Substances and Disease Registry's (ATSDR) Geospatial Research, Analysis & Services Program created an index and mapping tool to help public health and emergency response agencies identify communities that are at greater risk before, during, and after a disaster.[160] The SVI ranks each of the 14 social vulnerability variables from highest to lowest across all census tracts in the U.S. with a non-zero population. Per capita income is reverse coded, as a higher value indicates less vulnerability. A percentile rank is then calculated for each variable in each census tract using the following formula:

***Percentile Rank = (Rank-1) / (N-1)***

where N = the total number of data points.[160] These percentile ranks measure the level of social vulnerability of each census tract for each variable. The percentile rank for each variable can then be summed together to calculate the composite SVI percentile rank. Variables that belong in the following four SVI domains can also be combined to calculate theme-specific SVI ranks: 1) socioeconomic status (income, poverty, employment, and education variables); 2) household composition (age, single parenting variables); 3) minority status and language (race, ethnicity, and English-language proficiency variables); and 4) housing and transportation (housing structure, crowding, and vehicle access variables).[18] Percentile ranks for each theme are

calculated by adding the percentiles for the variables in each domain and then ordering the summed percentiles for each theme to determine theme-specific percentile rankings.[160]

When Flanagan et al. first developed the SVI, they attempted to validate the measure by mapping parts of their index with available measures of vulnerability following Hurricane Katrina. The SVI rank for the elderly vulnerability variable (population aged 65 or older) was overlaid with the flood zone boundaries that had significantly high or low rates of death from Katrina-related drowning.[18] Using Poisson regression, they found that of the fifteen census tracts with a statistically significant higher number of deaths than expected, eight were located within the most vulnerable category of elderly residents, with the remainder in middle SVI category with only one exception.[18] They additionally mapped the SVI socioeconomic domain against mail delivery data, which was a proxy measure for recovery, as it assessed the return of residents to the affected area. The results indicated that fewer households had resumed mail in lower SVI tracts, especially among those that experienced heavy damage from the hurricane.[18] In addition to Flanagan et al.'s initial validation of SVI, Bakkensen and colleagues have further validated this measure.[178] Using multiple linear regression models, they tested the association between the overall SVI measure on disaster declarations, property damage, and fatalities recorded at the county level in ten southeastern states. After controlling for several confounders, including disaster event magnitude and underlying risk for hazards, they found that higher scores of social vulnerability were significantly associated with greater property damage and fatalities.[178] Together these studies suggest that the SVI is a valid measure of social vulnerability to disasters.

*Healthy Places Index*

As previously described, the 25 indicators included in HPI come from different publically available data sources published by government institutions, non-profits, and universities. In

addition to having to meet the census population inclusion criteria, the specific variables were chosen based on 1) "actionability" through policy, systems, and environmental change, 2) continuity with the Healthy Disadvantage Index (a previous index of disadvantage in California that was later replaced by HPI), and 3) compatibility with indicator projects sponsored by the California Department of Public Health.[161] Each of the indicators belongs to one of eight domains of policy action (economy, education, healthcare access, housing, neighborhoods, clean environment, transportation, and social environment).

Before developing the index, each indicator was scaled in the same direction so that higher values meant greater advantage and were standardized by calculating its Z-score.[161] The HPI domain values were then generated by calculating mean Z-scores of the indicators included in the different HPI domains. A composite HPI score was then calculated by summing the HPI domain values using weights.[161] They estimated domain weights using a regression technique called weighted quantile score, which estimates the relative contributions of correlated variables that tend to cluster by domains and are associated with an independent outcome. The independent outcome that was used was life expectancy at birth, so the weights were estimated in order to optimize HPI's correlation with this outcome and its explained variance in simple linear regression.[161] Domain weights were 0.32 for economy, 0.19 for education, 0.05 for healthcare access, 0.05 for housing, 0.08 for neighborhoods, 0.05 for clean environment, 0.16 for transportation, and 0.10 for social environment.[161] These weights were checked using a sensitivity analysis using four alternative methods, none of which produced meaningfully different results. Percentiles were also calculated to rank California census tracts for each indicator, domain, and composite HPI scores.

The developers of HPI cross-validated the HPI indicators with other measures of community disadvantage used by California government agencies and local health departments. The comparison measures included CalEPA's CalEnviroScreen, the federal poverty level, 80% of the median household income, and the Intercity Hardship Index, which is used by the Los Angeles Department of Public Health. They generated proportions of agreement measures for the different index comparisons and found concordance for the vast majority of census tracts.[161] The positive predictive value of HPI with the federal poverty level, 80% of the median household income, and the Intercity Hardship Index ranged from 0.81 to 0.92.[161] The federal poverty level index had the fewest number of discordant census tracts with HPI. However, there was some disagreement among the HPI and CalEnvironScreen indices. Approximately 650 census tracts disagreed, with HPI having more counties that had the most disadvantaged 25% census tracts.[161] These counties were mostly located in California's north and central coast and Northern Sierras. They should therefore not affect the HPI data for the Los Angeles County census tracts I am studying, as the values for the census tracts in Southern California aligned with the CalEnvironScreen indices.

The developers of the HPI also published 45 additional decision-support indicators, including the wildfire risk variable that I used in my analysis. These indicators were considered to be important variables to be studied in conjunction with the census tract HPI scores and rankings.[161] The variables include measures of health outcomes that have substantial geographic coverage in census tracts in California urban areas, climate threats, measures of demographic and built environment indicators of climate change vulnerability or resilience, and additional candidate indicators for the HPI that did not meet all the inclusion criteria. These publically

available indicators were published with the most recent HPI data and were included in the HPI mapping application.

**Measures**

The main variables that I used from the PHRETS dataset are the following: measures of perceived health/disability, self-efficacy, response efficacy, neighborhood social capital, participation in different household and community preparedness behaviors, and socio-demographic characteristics. I additionally used both the domain and composite SVI and HPI measures for each of the sixteen communities, as well as the community wildfire risk measure published by the developers of HPI as a decision-support indicator to this index.

*Perceived Health/Disability Variables*

The PHRETS dataset contains four measures of health status, which were questions adopted from the Behavioral Risk Factor Surveillance System Questionnaire and the Los Angeles County Health Survey. Each of these variables was treated as a separate independent variable to test my overall focal relationship between disability and disaster preparedness. Self-rated health was measured by asking respondents "In general, would you say that your health is excellent, very good, good, fair, or poor?" Responses were reverse coded so that a higher score indicates worse self-rated health. This measure of self-rated health is well studied throughout the literature and has been shown to be a valid predictor of a number of conditions including mortality[179,180] and functional decline.[181,182] This ordinal measure was treated as ordinal in all models except for when conducting mediation analysis, which requires a dichotomous or continuous independent variable when assuming a path-analytic approach.[183] When conducting mediation analysis with the self-efficacy and response efficacy measures, I treated self-rated health as continuous.

Disability was also measured using the following three dichotomous (yes/no) questions: 1) Are you limited in any way in any activities because of a physical, mental, or emotional problems?; 2) Do you now have any health problems that require you to use special equipment such as a cane, a wheelchair, a special bed, or a special telephone?; and 3) Do you consider yourself a person with a disability? While these three variables have been previously combined into one measure of disability,[34,184] I decided to keep them separate and run them in separate models to test my focal relationship. Past research has demonstrated that when these measures are combined, there are differences in demographic and health characteristics when compared to other standardized disability measures.[185] By keeping my measures separate, I was able tease out the nuanced meanings of what it is like to possess a disability and study how differences in the way this construct is measured influence disaster preparedness behaviors. I additionally assessed overlap between these measures and examined the demographic distributions of each in order to better understand how each of these disability measures differ in their conceptualization of the disability construct.

*Self-Efficacy*

Two variables from the PHRETS dataset were used to measure self-efficacy. These variables were adapted from questions included in FEMA's 2009 Citizen Corps Survey. The questions asked respondents about their level of agreement with the following statements: 1) I am confident I can protect and help myself in the event of a disaster, such as an earthquake; and 2) I am confident I can be of help to my neighbors or community in the event of a disaster, such as an earthquake.

Responses followed a 4-point Likert scale that ranged from Strongly Disagree to Strongly Agree. The two questions were then summed to create a summative measure for self-efficacy,

which I treated as continuous. To verify that self-efficacy could be treated as unidimensional construct, I conducted a factor analysis with principal components extraction and Varimax rotation. There was only one eigenvalue over 1, an indication that it represents a unidimensional construct. The Cronbach alpha value associated with self-efficacy was equal to 0.751. This is above the generally accepted 0.7 cutoff, demonstrating that this measure possesses adequate reliability.

*Response efficacy*

Two PHRETS variables were used to measure response efficacy. These variables were adapted from questions included in FEMA's 2009 Citizen Corps Survey. The first question focused more on general perceptions of the effectiveness of planning for disasters and asked respondents about their level of agreement with the following statement: I don't think it really matters if you plan for disasters, such as a major earthquake. The second question asked about perceptions of the effectiveness of planning for disaster with neighbors, a measure that was oriented towards the benefits of community preparedness. This question asked respondents about their level of agreement with the following statement: Planning with my neighbors now won't help my household after an earthquake or other major disaster.

Each of these questions had a 4-point Likert scale that ranged from Strongly Disagree to Strongly Agree. The questions were negatively keyed so were later reverse coded so that higher disagreement meant higher efficacy. At first I considered combining these two measures to create a response efficacy index. However, when I generated a Cronbach alpha for this measure, the internal consistency was less than optimal (Cronbach alpha=0.651). I thus decided to treat each of these measures separately in order to assess how both perceptions of general response

efficacy and collective response efficacy mediate the relationship between disability and preparedness. These Likert scale questions were treated as continuous measures.

*Social Capital*

The PHRETS social capital measure was adapted from the 2008 Canadian General Social Survey, which contained modules focusing on social networks, civic engagement and housing and neighborhood characteristics in order to understand how Canadians mobilize their social networks to access resources during important periods of change in their lives.[186] This measure asked respondents "About how many people in your neighborhood do you know well enough to ask for a favor?" If clarification was needed, there was an additional prompt providing examples of a favor, such as bringing in your mail or package, helping you with a problem, or watching your place. Respondents chose from pre-established categories of responses that included knowing 0, 1-5, 6-10, and over 10 people. This variable was treated as ordinal in my analyses.

*Disaster Preparedness*

Ten binary yes/no questions about participation in preparedness behaviors (0=No, 1=Yes) were summed together to develop an index measure of disaster preparedness. These questions were chosen based on prior research examining patterns of preparedness behaviors.[144] This summative index could therefore be treated as a continuous variable, with higher values representing participation in a greater number of disaster preparedness behaviors. This variable was normally distributed, but was slightly positively skewed.

The behaviors included in the disaster preparedness index were based on the self-sufficiency and engagement levers of Chandra et al.'s community resilience framework.[76] These ten actions have also been previously combined using these methods and studied to assess preparedness behavior patterns in Los Angeles County.[87] The questions are the following: (1) A

three day supply of water is one gallon of water per person per day. Does your household have a 3-day supply of water for each person who lives there?; (2) Non-perishable foods do not need refrigeration or cooking, such as canned or packaged meat, soups, fruits and vegetables. Does your household have a 3-day supply of non-perishable food for each person who lives there?; (3) Does your household have a plan for how you will find each other or reunite if you are separated in a disaster?; (4) In the past 12 months, have you looked for information about getting prepared for a disaster, for example on the internet or by calling the Department of Public Health?; (5) In the past 12 months, have you talked with a neighbor about preparing for an emergency or disaster?; (6) In the past 12 months, have you attended a training to help others in your community in a disaster or emergency, like first aid or CPR?; (7) In the past 12 months, have you attended a community meeting where preparing for emergencies or disasters was discussed?; (8) In the past 12 months, have you bought additional emergency supplies of food, water, first aid supplies or other tools or items useful in a disaster?; (9) In the past 12 months, have you worked or volunteered, to help your neighborhood or community prepare for or respond to a disaster or emergency.; and (10) Psychological First Aid means helping others by listening to their concerns and needs, trying to help out where you can, and connecting them with other resources in the community after an emergency or disaster. In the past 12 months have you attended a training in Psychological First Aid?

*Social Vulnerability*

I used the four theme-specific SVI indices and a composite index to measure social vulnerability. The composite SVI variable is conceptualized as being multi-dimensional so I decided to both test how each of the dimensions measured by the SVI sub-indexes interact with the proposed focal relationship in addition to the composite SVI score. The four domains, which

were informed by previous social vulnerability research,[18] are socioeconomic status vulnerability, household composition vulnerability, minority status and language vulnerability, and housing and transportation vulnerability. Socioeconomic status vulnerability is made up of the following indicators: per capita income, persons below poverty, civilian (age 16+) unemployed, and persons (age 25+) with no high school diploma. Household composition vulnerability is comprised of persons aged 65 and older, persons aged 17 and younger, and single parent households with children under 18. Minority status and language vulnerability includes measures of all persons except non-Hispanic white and persons (aged 5+) who speak English "less than well." Housing and transportation vulnerability is made up of measures of crowding (at household level, more people than bedrooms), vehicle access (households with no vehicle available), and housing structure (housing in structures with 10 or more units; presence of mobile homes; persons in institutionalized groups quarters).

The CDC publishes percentile ranks (0 to 100) for each of the SVI domains and the composite SVI measure for every census tract in the U.S. that has a non-zero population. These percentile ranks are publically available. I later aggregated the census percentile ranks to the community level for each of the 16 Los Angeles County communities I studied and treated these variables as continuous. A description of this aggregation method will follow in data preparation and analysis section.

*Community Advantage*

I used HPI to measure community advantage of the 16 Los Angeles County communities. Like SVI, these measures exist as percentiles at the census tract level, but the rankings are only for California census tracts. I used both the composite HPI score as well as the HPI scores for each of eight domains (economy, education, healthcare access, housing,

neighborhoods, clean environment, transportation, and social environment) to study whether community-level resilience moderates the relationship between disability status and preparedness. A description of how data will be aggregated from census tract to community will be described in the next section. HPI indices are measured as percentiles and were treated as continuous variables.

The economy domain includes the following measures: percent of the population with an income exceeding 200% of federal poverty level, percent of population aged 25-64 who are employed, and median household income. The education domain is comprised of percent of population over age 25 with a bachelor's education or higher, percent of 15-17 year olds enrolled in school, and percent of 3 and 4 year olds enrolled in pre-school. The healthcare access domain just includes one measure of percent of adults aged 18 to 64 years currently insured. The housing domain was made up of the following indicators: percent of occupied housing units occupied by property owners, percent of households with complete kitchen facilities and plumbing, percent of low income homeowners paying more than 50% of income on housing costs, percent of low income renter households paying more than 50% of income on housing costs, and percent of households with less or equal to 1 occupant per room. The neighborhood domain includes the following variables: percent of the population living within 0.5 miles of a park, beach, or open space greater than 1 acre, population-weighted percentage of the census tract area with tree canopy, percent of the urban (or rural) population residing less than 0.5 (or 10) miles from a supermarket/large grocery store, percent of the population residing within 0.25 miles of an off-site sales alcohol outlet, and combined employment density for retail, entertainment, and educational uses. The clean environment domain contains measures of gridded diesel PM emissions from on- and off-road sources, drinking water contaminant index, mean daily

maximum 8-hour ozone concentration during summer months, and annual mean concentration of PM2.5. The social domain has measures of percent of registered voters and percent of family households with children under 18 with two parents. Finally, transportation is comprised of percent of households with access to an automobile and percent of workers (16 years+) commuting by walking, cycling, or transit.

*Wildfire Risk*

Wildfire risk was measured as the percent of the population currently living in very high wildfire risk areas. Very high wildfire risk areas are standardized measures of risk defined by CAL FIRE. This variable is available at the census tract level and is one of the Decision Support indicators published in conjunction with HPI. I later aggregated this census tract-level measure to the community level for each of the 16 PHRETS survey communities. A description of aggregation methods will follow in the data preparation and analysis section.

*Socio-Demographic Characteristics*

I also included age category (18-29, 30-44, 45-59, 60+), gender (male or female), and race/ethnicity (white, African American, Asian, Hispanic, other) variables from the PHRETS dataset in my regression analyses. These three variables are known predictors of disaster preparedness and are thus important control variables. While race/ethnicity was originally collected using similar methods as the U.S. Census Bureau, which separately measures predetermined categories of race and Hispanic ethnicity (Hispanic vs. non-Hispanic), the measures were combined due to a large number of respondents voluntarily categorizing their race as Hispanic or Latino. Those who listed their race as Hispanic/Latino who also indicated that they possess Hispanic ethnicity were recoded as being Hispanic in the combined race/ethnicity measure.

Other demographic variables included in the dataset are self-reported median household income (range: <$10,000 to >$100,000), education level (range: high school or less to college degree or higher), language used in home (English, Spanish, other), and number of children (17 or younger) in household. While I generated descriptive statistics for these variables, I did not include them in my regression analyses for two reasons. First, I wanted to conserve the parsimony of models tested, particularly because I ran multilevel models which reduces parsimony and statistical power to detect outcomes.[187] This argument is particularly strong for the language and number of children in household variables, as I do not possess a clear theoretical rationale for their inclusion in my models of disability and preparedness. Second, while income, education or a combination of these variables used as a proxy measure for socioeconomic status (SES) are important demographic variables to control for, chi-square tests demonstrate these variables are significantly associated with the communities in which individual respondents reside. Because I accounted for the fact individuals are clustered into communities, there is the potential to cause multicollinearity. I additionally included community-level measures of social vulnerability and community advantage that include variables related to community SES. The SVI measure is a moderately strong correlate of the individual-level education (Spearman $R=-0.41$, $p<0.001$) and income (Spearman $R=-0.40$). The HPI is also a moderate correlate of individual-level education (Spearman $R=0.39$, $p<0.001$) and income (Spearman $R=0.38$, $p<0.001$). I thus decided to not include individual-level SES measures in the models to help prevent issues with multicollinearity.

**Data Preparation & Analysis**

*Linear Regression Assumptions & Diagnostics*

Before testing my hypotheses, I first checked the linear regression assumptions and ran model diagnostics. The four main assumptions for a linear model are that 1) the relationships between the predictors and outcome variables in the model are linear, 2) the errors are normally distributed, 3) the error variances are constant (i.e. homoscedasticity), and (4) the errors associated with one observation are independent of the errors with any other observation (i.e. independence of errors).

I checked the first assumption by generating scatterplots of the different bivariate models that test the focal relationship. The self-rated health variable did appear to be linearly associated with disaster preparedness, with worse health trending towards lower preparedness. The remaining three disability measures were binary, so it was more difficult to observe a linear trend. However, it did appear that there was generally lower preparedness for those with a disability, as the regression line connecting 0 (no) and 1 (yes) for the health status questions trended downwards.

To test for normality of the residuals, I generated a distribution plot and a Normal Probability (QQ) plot for the residuals derived from each of the bivariate models that test the focal relationship. In general, the residuals appeared normally distributed, as shown by the bell shaped curves for each of the residual distribution plots (Appendix A). The QQ plots derived for each of the models also demonstrated that the residuals predominantly line up on the normal QQ line, with only some deviation at outlier residuals for the model with self-rated health as the independent variable (Appendix A). Based on these results, I concluded that there were no major violations to the normality of residuals assumption.

To test for homoscedasticity, I plotted the residuals vs. the predicted values for each of the focal relationship models. In each of the plots, the residuals appeared equally distributed

across the predicted values, with no evidence of fanning out or other deviations from constant variance of the residuals (Appendix B). I could therefore conclude that the homoscedasticity assumption was met.

For the independence of error assumption, the multilevel structure of the data violates this assumption as one could expect that the individuals within each community will tend to be more like each other than respondents from different communities. Errors associated with one observation may therefore be correlated with the errors of another observation. However, because I am accounting for this structure in multilevel models, the assumption is no longer needed.

In addition to checking the four main assumptions for linear regression, I also ran model diagnostics to make sure that there were no influential points that could introduce bias into the parameter estimates. I determined influential points by examining whether observations were outliers in X or Y, the Cook's distance was larger than $F_{0.05}$ (P+1, N-P-1), or the absolute value of the DFFITS was larger than $2(P+1)^{1/2}/(N-P-1)^{1/2}$ where N = the number of observations and P = the number of parameters including the intercept. I generated these statistics for each of my bivariate regression models that capture the focal relationship. I deleted the influential points and ran the models again. I then compared models with and without influential points in order to assess whether deleting them had a significant impact on the regression coefficients. There were no major differences in parameter estimates between the models with and without influential points so all observations were kept in the dataset.

*Multicollinearity Check*

To check for potential multicollinearity between age and the different disability measures, variance inflation factors (VIF) were generated. The VIF for self-rated health was 1.024, for activity limitations was 1.051, for presence of a health problem requiring the use of special medical

equipment was 1.054, and for considering yourself a person with a disability was 1.049. These values are well below accepted cutoffs, indicating that multicollinearity is not occurring. Including age as a covariate in each of these regression models should therefore not have adverse effects on regression coefficients.

*Aggregation of SVI and HPI Data*

Both SVI and HPI (including wildfire risk) are available at the census tract level whereas the PHRETS dataset is mapped to community and corresponding zip code(s). To map the zip code(s) to corresponding census tract(s), I used U.S. Department of Housing and Urban Development USPS zip code crosswalk files,[188] which provides publically available data on the 2010 census tracts that match with PHRETS sample zip codes based on the quarter and year they were collected. These files additionally provide a ratio of residential addresses in the census tract to all the residential addresses in the zip code. This ratio allowed me to weight the census tract SVI and HPI scores in each zip code according to the proportion of census households that are located in the corresponding zip code. For instance, one census tract may only contribute to 10% of the residential addresses in the zip code whereas another contributes to 50%, so the latter should contribute to a higher proportional weight when calculating the overall SVI and HPI percentiles for that zip code. Using this weighting method, I was able to calculate both composite SVI and HPI scores as well as domain-specific scores for each community by combing the weighted census tract percentiles for each zip code and then calculating the average score across all zip codes in the community.

The following formula was used to calculate SVI scores at the zip code level:

$$\boldsymbol{SVI_{zip}=\sum(SVI_{census} * R)}$$

where $SVI_{census}$ = SVI scores associated with each census tract in the zip code

R = ratio of residential addresses in census tract to all the residential addresses in zip code.

To compute the SVI of the community, I then calculated the average SVI among all zip codes contained in that community. This same methodology was applied to the HPI data as they are also available at the census tract level.

*Testing Multilevel Structure*

Conceptually it makes sense that there is a multilevel structure to the data given that each community was chosen based on a specific set of unifying characteristics. However, it is still possible that there would not be enough variance at the community level to justify a multilevel analysis. To test whether the data are in fact multilevel, I conducted a deviance test between two nested models in SAS. The smaller, nested model just contained the self-rated health as the independent variable and disaster preparedness as the outcome. The equation for this one-level model is the following:

$$\boldsymbol{Y_i = b_0 + b_1 X_i + e_i}$$

where $Y_i$ = disaster preparedness outcome for the ith individual

$b_0$ = intercept

$b_1$ = slope

$X_i$ = self-rated health for the ith individual

$e_i$ = error term for the ith individual.

The larger model possessed the same variables as the nested model in addition a random statement for the community level intercept to account for the higher level structure. The equations for this multilevel model are the following:

$$\boldsymbol{\text{Level 1: } Y_{ij} = b_{0j} + b_{1j} X_{ij} + e_{ij}}$$

$$\boldsymbol{\text{Level 2: } b_{0j} = g_{00} + u_{0j}}$$

$$\boldsymbol{b_{1j} = g_{10}}$$

where $Y_{ij}$ = disaster preparedness outcome for the ith individual in the jth community

$b_{0j}$ = level 1 intercept

$b_{1j}$ = level 1 slope for the ith individual in the jth community

$X_{ij}$ = self-rated health for the ith individual in the jth community

$e_{ij}$ = within community error term

$g_{00}$ = average intercept across communities

$u_{0j}$ = level 2 intercept error term

$g_{10}$ = average slope across communities.

Using the MIXED procedure in SAS, I ran these two nested models, which generated -2 log likelihood values. To conduct a deviance test, I calculated the difference between -2 log likelihood values from each of the models. I then ran a chi-square using the difference value ($\chi^2$=21.8) with 2 two degrees of freedom derived from the two additional error terms included in the larger model. Results from this test were significant ($p \leq 0.0001$), which indicates that the larger, multilevel model fit significantly better than the nested model. These results confirm that there is in fact a multilevel structure to the data.

When I continued to run my models to test my hypotheses, I conducted additional deviance tests between my nested models to assess goodness of fit. For models that did not contain level 2 covariates, I only included an error term for the intercept at level 2, as I am assuming that the slope is non-randomly varying at level 2. This is simplest form of model that I started with. For later models that included level 2 covariates, I included a random statement for their slopes. If the variance of the slope was non-significant, then this error term was removed. Finally, to assess how much variance there was between and within groups, I generated intraclass correlation coefficients for each of my models, which are included in the tables and results.

*Testing Dissertation Hypotheses*

Research Question #1 Hypothesis:

H1.1 proposes that there is a significant, negative association between my focal X and Y variables. To test the bivariate association, I first ran four separate simple linear regression models, with my 10-item preparedness index regressed on each of my disability variables. To further test my hypothesis, I then re-ran these four models using two-level hierarchical linear regression with Satterthwaite approximation for degrees of freedom. Each of these models included the following control variables: gender, age, and race/ethnicity. To account for the multilevel structure of the data, I included a random statement for the community level intercept and slope. If the error term for the slope was non-significant, it was removed from the model. A deviance test was conducted between each multilevel model and its corresponding single-level model to verify the multilevel structure. Intraclass correlation coefficients were also generated as descriptive statistics relating to the within versus between-community variance.

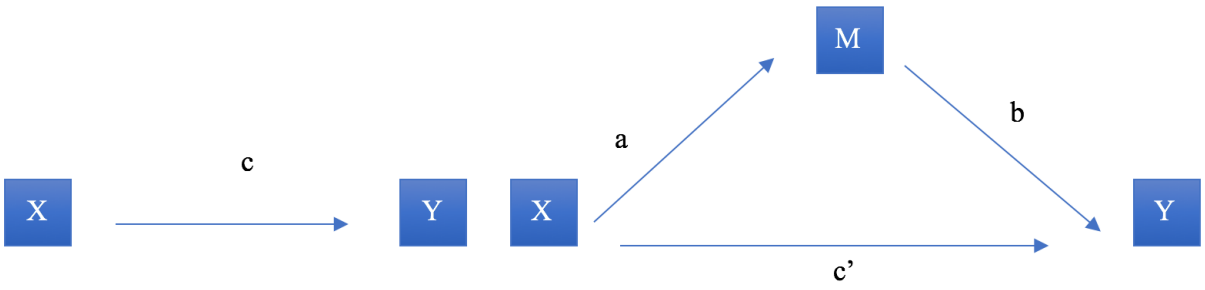
In addition to running regression analyses to test my overall focal relationship, I conducted a canonical correlation analysis to explore how my different disability measures correlate with the different preparedness behaviors included in my 10-item preparedness index. The canonical correlation coefficients allowed me to both test for the existence of overall linear relationships between my set of disability and preparedness variables as well as to explore whether certain preparedness behaviors are more strongly correlated with disability canonical variates and thus driving my results. To assess whether there was a linear association between my sets of focal variables and to confirm the number of significant canonical pairs between the two sets, I conducted a Likelihood ratio F test. I additionally generated Wilks' Lambda, Pillai's

Trace, Hotelling-Lawley Trace, and Roy's Greatest Root test statistics, which vary in their level of conservatism.

Research Question #2 Hypotheses:

The hypotheses associated with RQ2 propose that self-efficacy partially mediates the relationship between living with disabilities and disaster preparedness. This concept was broken up into three testable hypotheses: H2.1) There is an inverse relationship between disability status and self-efficacy so that people living with disabilities have lower self-efficacy for disaster preparedness in comparison to those who do not have disabilities; H2.2) There is direct relationship between self-efficacy and disaster preparedness so that self-efficacy is positively associated with participation in disaster preparedness behaviors; and H2.3) Self-efficacy for preparing for disasters partially mediates the relationship between living with disabilities and participation in disaster preparedness behaviors, with one's disability status associated with lower self-efficacy, a positive correlate of preparedness. To test these hypotheses, I conducted a mediation analysis based on Baron and Kenny's steps for mediation (Figure 4.1)[189] for each of my disability models. These steps were conducted at level 1 of the models, as each of the variables involved were measured at the individual level.

**Figure 4.1** Mediation Diagram Based on Baron & Kenny's (1986) Product Method




In figure 4.1, X is the independent variable (disability), M is the mediating variable (self-efficacy), and Y is the outcome variable (disaster preparedness). I conducted the mediation

analysis in four steps. The first step was to establish a statistically significant relationship between the focal independent and outcome variable (path c), which involved the methods previously described for testing the RQ1 hypothesis. I then determined whether there was a relationship between the independent variable and the mediation variable (path a) by regressing self-efficacy on each of the disability variables. If the coefficient was significant and negative, then H2.2 was supported. The third step was to test H2.3 by establishing whether there was a significant positive association between the mediator variable and the outcome variable (path b). This model contained both the focal independent variable (disability) and the mediator (self-efficacy). Finally, using this same regression model, I assessed the net direct effect of the focal independent variable on the outcome variable while taking into account the indirect effect of the mediator (c'). I hypothesized that self-efficacy contributes to partial mediation, so the direct effect of the focal relationship coefficient (c) will reduce in magnitude with the addition of the mediator (i.e. c'<c) but still remain statistically significant.

The equations associated with each of these steps are as follows:

***Step 1:*** $Y=b0_1 + b1_1X + e$

***Step 2:*** $M=b0_2 + b1_2X + e$

***Step 3 & 4:*** $Y=b0_3 + b1_3X + b2_3M + e$

where M=mediator

X = focal independent variable

Y = focal dependent variable.

$b0_1$ = intercept when Y is regressed on X

$b1_1$ = slope when Y is regressed on X

$b0_2$ = intercept when M is regressed on X

$b1_2$ = slope when M is regressed on X

$b0_3$ = intercept when Y is regressed on X and M

$b1_3$ = X slope when Y is regressed on X and M

$b2_3$ = M slope when M is regressed on X and M.

To estimate the mediated effect, I then calculated the point estimates by multiplying the a and b coefficients, also known as the product method.[189,190] The product method mediation estimates allowed me to test the mediated effect for a specific mediator and can also be summed for total mediated effect.[191] To test whether the mediation effect was statistically significantly different from 0 ($\alpha$=0.05), I used the Sobel test.[192] The Sobel test is a Z-test calculated by dividing the point estimate by the mediator standard error. The standard error (SE) of the mediator was estimated using the following formula:

$$SE_{med} = \sqrt{((SE(a)^2 * b^2) + (SE(b)^2 * a^2)}.$$ [192]

Research Question #3 Hypotheses:

The hypotheses associated with RQ3 propose that response efficacy mediates the relationship between living with disabilities and disaster preparedness. This proposal was broken up into three testable hypotheses: H2.1) There is an inverse relationship between disability status and response efficacy so that people living with disabilities have lower response efficacy for disaster preparedness in comparison to those who do not have disabilities; H2.2) There is direct relationship between response efficacy and disaster preparedness so that response efficacy is positively associated with participation in disaster preparedness behaviors; and H2.3) Response efficacy for preparing for disasters partially mediates the relationship between living with disabilities and participation in disaster preparedness behaviors, with one's disability status associated with lower response efficacy, a positive correlate of preparedness.

To test the RQ3 hypotheses, I conducted the same mediation steps that I described for the RQ2 hypotheses but using each of my two measures of response efficacy: general response efficacy and collective response efficacy. Again, I calculated the point estimate by multiplying the a and b coefficients. To test whether the mediation is statistically significant, I used the Sobel test ($\alpha$=0.05).[192] I hypothesized that the focal relationship will reduce in magnitude with the addition of the mediator, but that it will still remain significant (i.e. partial mediation).

Research Question #4 Hypothesis:

H4.1 proposes that social capital moderates the relationship between living with disabilities and disaster preparedness so that greater social capital reduces the negative relationship between the focal variables. To test for moderation, I included an interaction term between social capital and the disability variable. The equation at level 1 is as follows:

$$Y= b_0+b_1X+b_m(\text{Social Capital}) +b_i(X * \text{Social Capital}) +\dots b_pX_p + e.$$

where X = focal independent variable

Y = focal dependent variable

$X_p$ = additional covariates in the model

$b_m$ = slope of Y regressed on social capital

$b_i$ = interaction coefficient.

To test whether social capital moderates the relationship between disability and disaster preparedness, I examined whether the coefficient for the interaction term was statistically significant ($\alpha$=0.05) for each of my disability models. I hypothesized that the coefficient for the moderator would be positive and significant, indicating that that the inverse relationship between disability and preparedness behaviors is attenuated with higher levels of neighborhood social capital.

Research Questions 5 Hypothesis:

H5.1 proposes that community-level social vulnerability (SVI) moderates the relationship between living with disabilities and disaster preparedness. I first tested whether the total SVI score significantly moderates the focal relationship by including the variable as an interaction term with the disability variable. If the interaction term was significant, I additionally ran separate analyses with each of the SVI domains to test which domain was contributing to the results. The following equations represent the model used to test this hypothesis:

$$\textbf{Level 1: } Y_{ij} = b_{0j} + b_{1j}X_{ij} + e_{ij}$$

$$\textbf{Level 2: } b_{0j} = g_{00} + g_{01}SVI_j + u_{0j}$$

$$b_{1j} = g_{10} + g_{11}SVI_j$$

where $Y_{ij}$ = disaster preparedness outcome for the ith individual in the jth community

$b_{0j}$ = level 1 intercept

$b_{1j}$ = level 1 slope for the ith individual in the jth community

$X_{ij}$ = self-rated health for the ith individual in the jth community

$e_{ij}$ = within community error term

$g_{00}$ = average intercept across communities

$g_{01}$ = level 2 slope

$u_{0j}$ = level 2 intercept error term

$g_{10}$ = average slope across communities

$g_{11}$ = level 2 slope of interaction term.

When combined into a single formula, the interaction term becomes apparent:

$$Y_{ij} = g_{00} + g_{01}SVI_j + g_{10}X_{ij} + g_{11}X_{ij}*SVI_j + (u_{0j} + e_{ij}).$$

To test whether the SVI moderates the relationship between disability and disaster preparedness, I examined whether the coefficient for the interaction term was statistically significant ($\alpha$=0.05). I hypothesized that the coefficient for the moderator would negative and significant, indicating that the negative effect of disability on preparedness behaviors increases in magnitude as communities have higher social vulnerability.

Research Questions 6 Hypothesis:

H6.1 proposes that community-level advantage moderates the relationship between living with disabilities and disaster preparedness. I first tested whether the composite HPI index significantly moderated the focal relationship by including it as an interaction term with the disability variable. If the interaction term was significant, I additionally ran separate analyses with each of the HPI domains to test which domain was contributing to the results. The models are represented as the same equations presented for H5.1 but with SVI exchanged for HPI.

To evaluate the H6.1 hypothesis, I examined whether the coefficient for the interaction term was statistically significant ($\alpha$=0.05). I hypothesized that the coefficient for the moderator would be positive and significant, indicating that that the inverse relationship between disability and preparedness behaviors is reduced at higher levels of community advantage.

Research Questions 7 Hypothesis:

H7.1 proposes that wildfire risk moderates the relationship between living with disabilities and disaster preparedness so that the negative relationship between disability and preparedness is attenuated for those living in community with a higher percentage of people exposed to high risk of wildfires. To test this hypothesis, I used the same methods previously described for the RQ5 and RQ6 hypotheses ($\alpha$=0.05). The hypothesis was supported if the interaction term was significant and positive.

*Weighting Techniques*

When Abt Survey Sampling and Methodology Division collected and prepared the survey data, they calculated weights for each respondent in order to make the completed cases as representative as possible. The weighting was conducted using a raking ratio estimation. The raking estimation aligned sample age, gender and race/ethnicity data to population benchmarks for the 2010 census blocks in each of the 16 communities. They imputed missing values in the weighting variables using the modal response prior to raking. Raked weights were trimmed at the 2nd and 98th percentiles to decrease variance, a method known as Winsorizing.[193]

When using weights in multilevel analysis, bias can be introduced to the covariance parameter estimators.[194] Pfefferman et al. propose a weight-scaling method where level 1 weights are scaled to the sum of the actual number of completed cases in each level 2 cluster.[194] I conducted this scaling method on the level 1 weights in a data step in SAS in order to reduce potential bias when running the analyses.

Multilevel modeling requires that there are weights at both levels because the level 1 and level 2 sampling weights enter into the equation for the pseudo-likelihood estimates at different places.[195] However, the PHRETS dataset only provide individual weights, requiring estimation of the level 2 weights. To be able to calculate maximum likelihood estimates with weights in a multilevel model, Goldstein proposes the following formulas to estimate level 2 weights:

$$w'_j = mW_j/\sum W_j,\ W_j=(\sum w_{ij})/n_j$$

where $w'_j$=estimate of weight at jth level 2 unit

m=the total number of level 2 units

$w_{ij}$=the weight of the ith level 1 unit in the jth level 2 unit

$n_j$=the number of level 1 units in jth level 2 unit.[196]

By plugging in this this formula, I was able to compute level 2 weight estimates for each community.

Using the level 2 weight estimates and the scaled level 1 weights, I was able conduct multilevel analysis with the PHRETS survey data using the SAS GLIMMIX procedure. This procedure allows one to specify level 1 weights in the OBSWEIGHT= option in the MODEL statement and the level 2 weights on the WEIGHT= option in the RANDOM statement.[197]

*Missing Data*

Missing data can introduce bias into regression analysis, so before testing my research questions I had to decide how to address missing data. I examined the frequency of missing responses in the PHRETS dataset by generating frequency tables for each of the study variables. For the majority of the study variables, less than 5% of the responses were missing. It is assumed that a missing rate of 5% or less does not introduce bias into the analysis,[198] so the dataset was treated with listwise deletion (i.e. complete case analysis), the default method programmed into SAS regression procedures.

One of my variables, the outcome preparedness variable (9.1% missing), had between 5% and 10% of responses missing. I first considered conducting multiple imputation on this variable; however, this technique does not account for survey weights. While there is an alternative in SAS with the SURVEYIMPUTE procedure which uses a fractional hot-deck imputation technique,[199] this imputation method can still introduce bias, particularly when used on an outcome variable.[195] This technique assumes that the data are Missing at Random (MAR), which describes when missingness patterns are related to some of the observed data but not the data that are missing. Missing data techniques that assume MAR thus need to incorporate variables that are related to the missingness in order to control for these effects. This assumption cannot be met

when we impute on an outcome variable, as we do not control for potential observed data that is contributing to the missingness pattern.[195] I therefore decided to treat all of my variables with the listwise deletion method. Given the low percentages of missing data for each variable (<10%), this method should be sufficiently robust to use in my analyses.[200–202]

Chapter 5. Results: Disability and Disaster Preparedness

People living with disabilities are at greater risk for the negative health consequences of disasters. Not only are the built infrastructure and emergency procedures generally designed for people without disabilities,[25] but overlapping demographic and social factors, including poor living conditions, higher poverty rates, and societal stigmatization, place people with disabilities at greater risk during a disaster.[26,27] Accounts from recent disastrous events, such as 2017's Hurricane Harvey which affected the Gulf Coast and the wildfires in Northern California, further exemplify the vulnerabilities and lack of planning for these individuals.

Despite being at greater risk for harm, there is evidence demonstrating that people living with different types of disabilities and health conditions are less prepared for disasters than the general population.[33–37] Research, however, is limited, with few studies exploring why this population is less engaged in different disaster preparedness behaviors. In the following chapters, I will present results assessing the focal relationship of disability and disaster preparedness, as well as the pathways and moderating factors that help elucidate why people with disabilities are less prepared.

**Overview of Hypothesis and Methods**

The focus of this chapter is to summarize the results evaluating H1.1, the hypothesis associated with this dissertation's focal relationship. This hypothesis proposes that there is an inverse relationship between disability status and disaster preparedness so that people living with disabilities participate in fewer disaster preparedness behaviors in comparison to those who do not have disabilities.

Prior to testing this hypothesis, I first generated descriptive statistics to understand the demographics of the study population, the prevalence of people living with disabilities, and the number of disaster preparedness behaviors performed by participants within each community. I also ran various cross tabulations of the disability variables with each other as well as with different demographic characteristics in order to better understand how my focal independent variables overlap with and vary from each other.

To test the focal hypothesis, I first generated bivariate statistics by regressing the 10-item preparedness index on each of the disability measures in simple linear regression models. The first model contained self-rated health as the main predictor variable. The second model's main predictor was the presence of activity limitations. The third model possessed a measure of presence of health problems requiring the use of the special medical equipment. The fourth model contained a measure of whether one considered themselves a person with a disability as the main predictor variable.

After assessing bivariate associations, I ran four multilevel regression models of disaster preparedness on each disability measure. Each of these models controlled for age, gender and race/ethnicity. Two-level non-varying slope models were conducted to account for the multilevel structure of individuals being clustered into communities. Both individual and community weights were applied to the models.

Finally, in order to explore what individual behaviors included in the preparedness outcome were driving the focal relationship, I conducted a canonical correlation analysis. This exploratory analysis included one set of the four disability measures and another set of the ten disaster preparedness variables.

**Descriptive Statistics**

Table 5.1 presents the socio-demographic characteristics of the study population after individual weighting. The majority of respondents were female (52%), between 30 and 44 years old (31%), white (40%), possessed at least a college degree (34%), earned a household income between $10,000 and $30,000, did not possess a child in the household (52%), and spoke mostly English in the home (57%). Generally, these demographics reflect similar distributions of gender, age, and race/ethnicity in Los Angeles County based on data from the 2010 Census.[203] However, the sample tended to have a greater proportion of respondents that possessed higher education (both high school and college graduates), spoke English in the home, and had a lower household income than the general Los Angeles County population.[204] There was also a lower proportion of people indicating Hispanic ethnicity, which may have resulted from the distinct way race and ethnicity were measured and combined using the PHRETS dataset.

Table 5.2 presents the percentages of respondents indicating that they report some form of disability, as well as measures of their self-rated health after individual weighting. Nearly one fifth of respondents indicated that they had fair or poor health (20%) and that they were limited in activities in any way due to physical, mental, or emotional problems (17%). These frequencies are consistent with both national and Los Angeles County reports of approximately 19% of the population living with some type of disability.[24,205] Fewer respondents, on the other hand, indicated they considered themselves a person with a disability (12%) or had a health problem requiring use of special medical equipment (7%). Exploration of how these different measures of disability status differ from each other was later assessed by generating cross tabulation statistics.

**Table 5.1** Sample characteristics of respondents after weighting, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Variables** | | **n (%)** |
|---|---|---|
| Gender | Male | 2274 (48%) |
| | Female | 2418 (52%) |
| Age | 18-29 | 1026 (22%) |
| | 30-44 | 1445 (31%) |
| | 45-59 | 1260 (27%) |
| | 60+ | 941 (20%) |
| Race/ethnicity | White | 1829 (40%) |
| | African American | 440 (10%) |
| | Asian | 471 (10%) |
| | Hispanic | 1537 (34%) |
| | Other | 239 (5%) |
| Income | <$10,000 | 444 (11%) |
| | $10,000-29,999 | 1157 (29%) |
| | $30,000-49,999 | 842 (21%) |
| | $50,000-99,999 | 928 (23%) |
| | ≥$100,000 | 652 (16%) |
| Education | Some high school or less | 691 (15%) |
| | High school graduate/GED | 1164 (25%) |
| | Associate degree/trade school/ some college | 1243 (26%) |
| | College degree or higher | 1602 (34%) |
| Child in household | Yes | 2242 (48%) |
| | No | 2458 (52%) |
| Language | English | 3068 (66%) |
| | Spanish | 1262 (27%) |
| | Other | 310 (7%) |

**Table 5.2** Measures of disability after weighting, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Variables** | | **n (%)** |
|---|---|---|
| Self-rated health | Poor | 156 (3) |
| | Fair | 778 (17) |
| | Good | 1407 (30) |
| | Very good | 1275 (27) |
| | Excellent | 1070 (23) |
| Limited in activities from physical, mental, or emotional problems | Yes | 797 (17) |
| Presence of health problem requiring use of special medical equipment (e.g. cane, wheelchair, special bed, or a special telephone) | Yes | 349 (7) |
| Consider yourself a person with a disability | Yes | 566 (12) |

Table 5.3 presents the percentages of respondents with disabilities across the sample communities after weighting. The results demonstrate that there was some variability in the distribution of disability measures by community. In particular, the Compton, Watts, and Gardena samples had higher than average percentages of people with disabilities across all measures. These three communities belong to the South and South Bay SPAs, which possess the highest prevalence of reported disability[205] and worse self-rated health,[206] and are thus consistent with expected variation in disability measures. Acton/Agua Dulce and La Crescenta also possessed lower than average percentages of people with disabilities across all measures. While La Crescenta is located in the San Fernando Valley which is an area with lower than average disability prevalence, Acton/Agua Dulce is located in the Antelope Valley, which has a higher prevalence and thus this sample may be less representative of the entire population of the region.[205] This findings is not particularly surprising given that communities were weighted to be representative of themselves and not the entire SPA in which they reside.

**Table 5.3** Cross tabulation of sample communities with disability measures after weighting, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Variables** | Fair/poor Health n (%) | Activity limitations n (%) | Require use of special equipment n (%) | Consider yourself a person with disability n (%) |
|---|---|---|---|---|
| Community | | | | |
| Acton/Agua Dulce | 25 (10.6) | 35 (14.9) | 12 (5.1) | 25 (10.6) |
| Compton | 99 (28.3) | 69 (19.7) | 35 (10) | 46 (13.1) |
| Culver City | 56 (16.0) | 54 (15.4) | 25 (7.1) | 41 (11.7) |
| Gardena | 79 (22.6) | 75 (21.4) | 29 (8.3) | 60 (17.1) |
| Hawaiian Gardens | 44 (27.8) | 23 (14.6) | 12 (7.6) | 15 (9.5) |
| Hollywood | 49 (14.0) | 58 (16.6) | 20 (5.7) | 45 (12.9) |
| Huntington Park | 76 (27.7) | 34 (12.4) | 19 (6.9) | 20 (7.3) |
| La Crescenta | 36 (10.3) | 48 (13.7) | 18 (5.1) | 28 (8.0) |
| Palms | 35 (12.2) | 46 (16.0) | 12 (4.2) | 27 (9.4) |
| Pico Union | 50 (19.5) | 42 (16.4) | 26 (10.2) | 32 (12.5) |
| Pomona | 72 (21.4) | 48 (14.3) | 25 (7.4) | 39 (11.6) |
| Quartz Hill | 53 (15.8) | 81 (24.1) | 32 (9.5) | 54 (16.1) |
| San Fernando | 56 (20.4) | 41 (14.9) | 17 (6.2) | 28 (10.2) |
| San Gabriel | 46 (17.4) | 43 (16.2) | 17 (6.4) | 25 (9.4) |
| Watts | 87 (32.5) | 52 (19.4) | 29 (10.8) | 46 (17.2) |
| Wilmington | 73 (28.2) | 49 (18.9) | 21 (8.1) | 36 (13.9) |
| Total | 934 (20.3) | 797 (16.8) | 349 (7.4) | 566 (11.9) |

Results from the mean number of preparedness behaviors per community are presented in Table 5.4. Sample respondents from all communities participated in a mean of 3.3 behaviors of the 10 possible preparedness actions included in the preparedness index. Certain communities possessed more extreme measures of preparedness. Most notably, Acton/Agua Dulce possessed a mean participation of 4.01 preparedness behaviors. The 95% confidence interval (CI) for Acton/Agua Dulce did not overlap with the 95% CI of the overall mean, indicating that the mean number of behaviors for this community was significantly greater. Residents of Pomona (Mean=2.97) and San Gabriel (Mean=2.98) also participated in a relatively low mean number of preparedness behaviors, though these results did not significantly differ from the overall mean.

**Table 5.4** Mean number of preparedness behaviors by community after weighting, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Variables** | Mean number of preparedness behaviors (SD[a]) |
|---|---|
| Community | |
| Acton/Agua Dulce | 4.01 (2.01)[b] |
| Compton | 3.39 (2.35) |
| Culver City | 3.45 (2.41) |
| Gardena | 3.14 (2.41) |
| Hawaiian Gardens | 3.07 (2.24) |
| Hollywood | 3.02 (1.97) |
| Huntington Park | 3.39 (2.23) |
| La Crescenta | 3.51 (2.10) |
| Palms | 3.05 (1.94) |
| Pico Union | 3.28 (1.95) |
| Pomona | 2.97 (2.18) |
| Quartz Hill | 3.28 (2.19) |
| San Fernando | 3.34 (2.11) |
| San Gabriel | 2.98 (1.97) |
| Watts | 3.71 (2.38) |
| Wilmington | 3.24 (2.34) |
| Overall Mean (SD) | 3.3 (2.19) |

[a]SD=Standard Deviation
[b]95% confidence interval (CI) does not overlap with 95% CI of overall mean

**Cross Tabulations of Disability Measures**

Table 5.5 presents the results of cross tabulation frequencies of the four disability measures. As expected, there were higher percentages of people with worse self-rated health who also indicated that they possess activity limitations, require the use of special medical equipment, and who consider themselves to be a person with a disability. This finding was particularly pronounced for individuals requiring the use of special equipment, of which 57.1% rated their health as fair or poor. While there was some overlap between the separate measures of disability, the results also suggest that certain variables are more extreme measures of disability status. For instance, only 52.1% of people who possessed activity limitations considered themselves to have a disability, and only 33.9% required the use of special equipment. On the other hand, a large majority of respondents who considered themselves to have a disability (74.8%) and required the

use of special equipment (77.6%) also possessed activity limitations. These trends suggest that those who answered yes to these latter and potentially more extreme measures of disability were more likely be characterized by multiple measures of disability. However, there was still a large proportion of respondents who *only* indicated yes to being limited in activities, which is a more generalized measure of disability status. The different disability variables thus appear to represent distinct features of the disability construct.

**Table 5.5** Cross tabulation of different disability variables, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Variables** | | Activity limitations n (%) | Require use of special equipment n (%) | Consider yourself a person with disability n (%) |
|---|---|---|---|---|
| Self-rated health | Poor | 119 (14.9) | 84 (24.1) | 97 (17.2) |
| | Fair | 280 (35.2) | 115 (33.0) | 193 (34.3) |
| | Good | 216 (27.2) | 85 (24.4) | 151 (26.9) |
| | Very good | 124 (15.6) | 47 (13.6) | 75 (13.3) |
| | Excellent | 57 (7.2) | 17 (4.9) | 47 (8.4) |
| Activity limitations | | -- | 270 (77.6) | 414 (74.8) |
| Require use of special equipment | | 270 (33.9) | -- | 254 (45.0) |
| Consider yourself a person with a disability | | 414 (52.1) | 254 (73.1) | -- |

The results from the cross tabulations between disability variables and demographic characteristics are located in Table 5.6. In general, the results demonstrate that a greater percentage of respondents with disabilities were female, older, less educated, and possessed lower income. These trends are consistent across the four disability measures and also reflect findings from the literature.[203,207] People with disabilities were additionally more likely to speak English in the home and possess children in the household.

Despite making up only 10% of the entire sample, African Americans were overly represented with disabilities. In particular, 22.4% of people who required the use of special medical equipment were African American. The proportion of people with disabilities was also

relatively low for Asians who comprised 10% of the overall sample. These results are similar to the estimates of racial distribution by disability status from the American Community Survey, which measures disability as having at least one of six possible health limitations.[203,208]

When comparing the demographics of the three separate disability measures, certain trends were stronger for the more extreme measures of disability. For example, the increasing disability trend with older age was more pronounced among people who require the use of special equipment than both those who consider themselves to be a person with a disability and those who have activity limitations. African American race, English language, and presence of children in the household also followed this pattern. However, the differences in frequencies of these demographic characteristics remained small, suggesting that respondents who fall into different categories of disability still possess similar demographics.

The distribution of certain demographic characteristics also differed between respondents with fair or poor health and the three other disability measures. Instead of increasing in proportion at every age, those who rated their health as fair or poor peaked at ages 45 to 59 (31.4%) and then slightly decreased over 60 (29.0%). This finding may be a reflection of the complex contextual evaluation of health at older age groups. As noted by Jylhä's (2009) empirically informed conceptual model of self-rated health, older individuals often base their self-assessments of health on comparisons with age peers.[209] Self-rated health thus acts as more of a relative interpretation of health based on social and temporal comparison than an absolute measure of functional limitation.[209] Additionally, the results demonstrate that there was a greater proportion of respondents with fair/poor health who indicated that they speak Spanish in the home than the other three disability measures. This may be a reflection of strong cultural

influence on the interpretation of self-rated health. Differences in perceived health by language, culture of origin, and ethnic groups are well documented in the literature.[209]

**Table 5.6** Cross tabulation of respondent demographics with disability measures after weighting, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Variables | | Fair/poor Health n (%) | Activity limitations n (%) | Require use of special equipment n (%) | Consider yourself a person with disability n (%) |
|---|---|---|---|---|---|
| Gender | Male | 419 (44.8) | 359 (45.1) | 146 (41.7) | 278 (49.1) |
| | Female | 516 (55.2) | 438 (54.9) | 203 (58.3) | 288 (50.9) |
| Age | 18-29 | 139 (14.9) | 107 (13.5) | 20 (5.7) | 62 (11.1) |
| | 30-44 | 229 (24.7) | 134 (16.9) | 32 (9.4) | 79 (14.1) |
| | 45-59 | 292 (31.4) | 252 (31.8) | 106 (30.7) | 186 (33.1) |
| | 60+ | 269 (29.0) | 300 (37.8) | 187 (54.2) | 235 (41.8) |
| Race/ethnicity | White | 262 (29.3) | 337 (43.9) | 148 (44.4) | 230 (42) |
| | African American | 112 (12.5) | 125 (16.3) | 75 (22.4) | 114 (20.8) |
| | Asian | 76 (8.5) | 54 (7.0) | 15 (4.6) | 35 (6.4) |
| | Hispanic | 396 (44.2) | 192 (25.0) | 83 (24.8) | 136 (24.9) |
| | Other | 49 (5.5) | 60 (7.8) | 12 (3.7) | 32 (5.9) |
| Income | <$10,000 | 163 (20.6) | 126 (18.8) | 58 (20.1) | 110 (23.2) |
| | $10,000-29,999 | 334 (42.2) | 238 (35.5) | 117 (40.9) | 176 (37.1) |
| | $30,000-49,999 | 150 (18.9) | 129 (19.2) | 52 (18.1) | 88 (18.4) |
| | $50,000-99,999 | 100 (12.6) | 117 (17.5) | 35 (12.2) | 64 (13.5) |
| | ≥$100,000 | 45 (5.7) | 60 (9.0) | 25 (8.7) | 37 (7.8) |
| Education | Some high school or less | 267 (29.3) | 108 (14.0) | 40 (11.9) | 68 (12.5) |
| | High school graduate/GED | 252 (27.6) | 200 (26.0) | 98 (28.9) | 175 (31.8) |
| | Associate degree/trade school/ some college | 220 (24.0) | 236 (30.6) | 106 (31.3) | 174 (31.7) |
| | College degree or higher | 174 (19.1) | 227 (29.4) | 95 (27.9) | 132 (24.0) |
| Children in household | Yes | 514 (55.0) | 541 (67.8) | 263 (75.4) | 409 (72.3) |
| | No | 420 (45.0) | 257 (32.2) | 86 (24.6) | 157 (27.7) |
| Language | English | 485 (52.5) | 566 (71.7) | 267 (78.2) | 427 (76.5) |
| | Spanish | 389 (42.0) | 173 (21.9) | 61 (17.9) | 106 (19.1) |
| | Other | 51 (5.5) | 51 (6.4) | 13 (3.9) | 25 (4.4) |

**Testing the Focal Relationship**

To first explore the bivariate relationship between each of my disability measures and disaster preparedness outcome, I ran simple linear regression models with individual weights. Results from these models are located in Table 5.7. While each of the disability measures were negatively associated with preparedness, only self-rated health and activity limitations yielded significant results. In comparison to those with excellent health, those with good (B=-0.1382, p<0.001), fair (B=-0.2926, p<0.001), and poor (B=-0.7023, p<0.001) health were negatively associated with engaging in preparedness behaviors, with a decreasing trend for worse levels of health. Very good self-rated health was non-significant with preparing for disaster in comparison to excellent health (B=-0.0233, p=0.315). Being limited in from physical, mental, or emotional problems was also negatively associated with preparing for disaster (B=-0.045, p=0.003) in comparison to those who are not limited.

**Table 5.7** Bivariate associations between different disability measures and disaster preparedness from simple linear regression models, Public Health Response to Emergent Threats Survey 2013 (N=4700)

| **Independent Variable** | **Standardized Beta Coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.7023 | <0.001 |
| Fair | -0.2926 | <0.001 |
| Good | -0.1382 | <0.001 |
| Very good | -0.0233 | 0.315 |
| Excellent (reference) | -- | -- |
| Limited in activities from physical, mental, or emotional problems | -0.045 | 0.003 |
| Presence of health problem requiring use of special medical equipment | -0.010 | 0.534 |
| Consider yourself a person with a disability | -0.014 | 0.358 |

Next, to fully assess H1.1., I ran four multivariable hierarchical linear regression models between each of the disability measures and the preparedness index. In addition to accounting for the multilevel structure of the data by including a random statement for the community level

intercept, gender, age and race/ethnicity were also included as individual-level covariates in each of the models. Table 5.8 presents the results of the model with self-rated health as the main predictor variable. In comparison to those who possessed excellent health, those who rated their health as good (B=-0.4284, p=0.002), fair (B=-0.6936 p<0.001), or poor (B=-0.7660, p<0.001) were significantly negatively associated with preparedness, with a decreasing trend for lower ratings of health. These results support H1.1, the proposed hypothesis for the focal relationship. In comparison to males, females were also significantly negatively associated with engaging in disaster preparedness behaviors (B=-0.2860, p<0.001). Age also demonstrated an increasing trend, though only individuals who were over the age of 60 years old were significantly associated with greater preparedness when compared to the youngest age group of 18 to 29 years old. Race/ethnicity was not significantly associated with the disaster preparedness outcome.

To assess the goodness of fit of this model, I conducted a deviance test between this model and a multiple linear regression model that is nested within it. The smaller model just contained preparedness regressed on self-rated health, age, gender and race/ethnicity, with individual survey weights. Results from the chi-square using the difference of the -2 log likelihood values ($\chi^2$=885.7) with 2 two degrees of freedom derived from the two additional error terms included in the larger model were statistically significant (p<0.001). The multilevel model therefore had a statistically significantly better fit than a single level multiple linear regression model, justifying the use of a multilevel analysis. I additionally generated an intraclass correlation coefficient to assess the proportion of between community variance. Though most of the variance was within communities (91.1%), 8.9% of the variance was between communities.

**Table 5.8** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated heath, gender, age, and race/ethnicity, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.7660 | <0.001 |
| Fair | -0.6936 | <0.001 |
| Good | -0.4284 | 0.002 |
| Very good | -0.0949 | 0.306 |
| Excellent (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2860 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0392 | 0.749 |
| 45-59 | 0.2551 | 0.076 |
| 60+ | 0.3733 | 0.015 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1604 | 0.262 |
| Asian | -0.3403 | 0.090 |
| Hispanic | 0.0879 | 0.496 |
| Other | 0.2659 | 0.304 |
| Likelihood ratio deviance test | $\chi^2$=885.7 | p<0.001 |
| Intraclass correlation coefficient | R=0.089 | -- |

Table 5.9 presents the results of the multivariable hierarchical linear regression analysis of disaster preparedness regressed on activity limitations. Those who indicated that they were limited in activities from physical, mental or emotional problems were significantly negatively associated with preparedness (B=-0.2294, p=0.035), supporting the focal relationship (H1.1) hypothesis. Again, being male and over the age of 60 were positively associated with the preparedness outcome while race/ethnicity was not significant.

Results from the deviance test using the -2 log likelihood ratio values of this model and a nested, single-level model were significant ($\chi^2$=977.9, p<0.001). The multilevel model therefore fit significantly better than a single-level multiple regression model. The intraclass correlation

coefficient was equal to 0.092, so 9.2% of the variance in the model was between communities. In other words, the majority (90.8%) of the variance was within communities.

**Table 5.9** Multivariable hierarchical linear regression analysis of disaster preparedness on activity limitations, gender, age, and race/ethnicity, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Limited in activities from physical, mental, or emotional problems | | |
| Yes | -0.2294 | 0.035 |
| No (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2902 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0332 | 0.766 |
| 45-59 | 0.2037 | 0.122 |
| 60+ | 0.3130 | 0.014 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1473 | 0.346 |
| Asian | -0.374 | 0.072 |
| Hispanic | 0.0243 | 0.833 |
| Other | 0.2861 | 0.261 |
| Likelihood ratio test | $\chi^2$=977.9 | P<0.001 |
| Intraclass correlation coefficient | R=0.092 | -- |

Table 5.10 presents the results of the multivariable hierarchical linear regression analysis of disaster preparedness regressed on the presence of health problems requiring the use of the special medical equipment. As hypothesized, there was a negative coefficient linking these two focal variables; however, the results were non-significant (B=-0.0893, p=0.439), rejecting H1.1 for this variable. In this model, age also became a non-significant predictor, with only female gender significantly negatively associated with preparedness.

Results from the deviance test using the likelihood ratio values of this model and a smaller, nested model were significant ($\chi^2$=1097.5, p<0.001), demonstrating better fit than a

multiple regression model. Though most of the variance was within communities (92.6%), a moderate 7.4% of the variance was between communities.

**Table 5.10** Multivariable hierarchical linear regression analysis of disaster preparedness on requiring the use of special medical equipment, gender, age, and race/ethnicity, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Presence of health problem requiring use of special medical equipment (e.g. cane, wheelchair, special bed, or a special telephone) | | |
| Yes | -0.0893 | 0.439 |
| No (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.3022 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0027 | 0.982 |
| 45-59 | 0.1565 | 0.283 |
| 60+ | 0.2415 | 0.1124 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1302 | 0.386 |
| Asian | -0.3917 | 0.049 |
| Hispanic | -0.0017 | 0.989 |
| Other | 0.2433 | 0.335 |
| Likelihood ratio test | $\chi^2$=1097.5 | P<0.001 |
| Intraclass correlation coefficient | R=0.074 | -- |

Results from the final model assessing the focal relationship are located in Table 5.11. As with the former model, considering yourself a person with a disability was negatively associated with preparedness but the coefficient in not statistically significant (B=-0.0090, p=0.943), rejecting H1.1 for this variable. In this model, only female gender was significantly negatively associated with preparedness. Results from the deviance test using the likelihood ratio values of this model and a smaller, nested model were significant ($\chi^2$=1101.1, p<0.001). This model thus fit significantly better than a multiple regression model. The intraclass correlation coefficient

was equal to 0.090, indicating that 9% of the variance was between communities and 91% within communities.

**Table 5.11** Multivariable hierarchical linear regression analysis of disaster preparedness on considering yourself a person with a disability, gender, age, and race/ethnicity, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Consider yourself a person with a disability | | |
| Yes | -0.0090 | 0.943 |
| No (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.3024 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | -0.0002 | 0.999 |
| 45-59 | 0.1489 | 0.304 |
| 60+ | 0.2280 | 0.137 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1120 | 0.456 |
| Asian | -0.3918 | 0.052 |
| Hispanic | -0.0048 | 0.969 |
| Other | 0.2410 | 0.341 |
| Likelihood ratio test | $\chi^2$=1101.1 | P<0.001 |
| Intraclass correlation coefficient | R=0.090 | -- |

Results from the four models testing the focal relationship demonstrate that only two of the models supported the hypothesis that disability is negatively associated with engaging in disaster preparedness behaviors. This finding may be a reflection of the weakness of two latter disability measures, though further interpretation about why only two of the four models are significant will be discussed in Chapter 8. Despite the null findings for two of the disability measures, I still conducted mediation analyses using all four of the disability variables in the next chapter. It is possible that the effect of X on Y may be non-significant when direct and mediated

effects have opposite signs, a phenomenon called inconsistent mediation or suppression.[154,190] I therefore continued to analyze these variables as planned.

**Canonical Correlation Analysis**

To assess what indicators were driving the focal relationship, I performed a canonical correlation analysis between my four disability measures and the ten behaviors that make up my preparedness index. Canonical correlation is a statistical technique that identifies canonical variates, which are similar to latent variables in factor analysis, except that canonical variates also maximize the correlation between the two sets of variables. The canonical variates are linear combinations of the disability variables and the preparedness variables that can deconstruct how the independent variables are correlated with different items making up the dependent variable.[210] Because the smaller of the two sets of variables of the focal variables was equal to four, four canonical variates were generated. Results from the significant tests assessing the null hypothesis that the canonical correlations are equal to zero (i.e. no linear relationship) are presented in Table 5.12.

The first canonical variate, which represents the linear combination of the disability measures and preparedness measures with the highest possible correlation, had a canonical correlation coefficient equal to 0.1621. This value is similar to the multiple correlation coefficient between a set of X and Y variables.[210] There were three other sets of linear combinations of the variables which generate correlation coefficients. The second pair of canonical variates had a coefficient of 0.0709, the third pair 0.0542, and the fourth pair 0.0309. Results from Likelihood ratio F test confirmed that I could reject the null hypothesis that all four canonical correlations are equal to zero ($p<0.001$), which was also confirmed by the Wilks' Lambda ($p<0.001$), the Pillai's Trace ($p<0.001$), the Hotelling-Lawley Trace ($p<0.001$), and the

Roy's Greatest Root statistics ($p<0.001$). However, only the first canonical correlation pair was statistically significant, whereas combinations of the second ($p=0.083$), third ($p=0.423$), and fourth ($p=0.776$) pairs were all non-significant. These findings demonstrate that there is a statistically significant linear relationship between the disability and the preparedness variables, but that I should only summarize results from the first canonical variate as it is the only one that possessed a significant linear relationship.

**Table 5.12** Canonical correlation analysis multivariate statistics and F approximations, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| | **Canonical correlation coefficient** | **p value** |
|---|---|---|
| First canonical correlation | 0.1621 | <0.001 |
| Second canonical correlation | 0.0709 | 0.083 |
| Third canonical correlation | 0.0542 | 0.423 |
| Fourth canonical correlation | 0.0309 | 0.776 |
| **Statistic** | **F test** | **p value** |
| Wilks' Lambda (F value) | 3.76 | <0.001 |
| Pillai's Trace (F value) | 3.74 | <0.001 |
| Hotelling-Lawley Trace (F value) | 3.78 | <0.001 |
| Roy's Greatest Root (F value) | 11.36 | <0.001 |

By examining how each of the variables correlate with their respective canonical variate, I was able to first understand the structure of that variate. Results demonstrating how the disability variables correlate with their canonical variate are located in Table 5.13. Each of the four disability variables were negatively correlated with this variate. Worse self-rated health had a very strong negative correlation with this variate ($R=-0.99$), possessing activity limitations had a medium-high negative correlation ($R=-0.42$), and requiring the use of special medical equipment ($R=-0.29$) and considering yourself to be person with a disability had medium-low negative correlations ($R=-0.27$). This variate could therefore be summarized as a measure of

disability that strongly emphasizes self-rated health, with additional variance accounted for by activity limitations followed by the two latter extreme variables of disability status.

**Table 5.13** Correlation between disability canonical variate and disability variables, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Variables | Disability variate |
|---|---|
| Worse self-rated health | -0.99 |
| Limited in activities from physical, mental, or emotional problems | -0.42 |
| Presence of health problem requiring use of special medical equipment | -0.29 |
| Consider yourself a person with a disability | -0.27 |

Results presenting the correlations between the preparedness variables and their corresponding canonical variate are located in Table 5.14. The first canonical variate for the preparedness variables was moderately positively correlated with all preparedness variables. In particular, the highest correlations are for looking for information about getting prepared for a disaster (R=0.64), having a 3-day supply of non-perishable food (R=0.59), and attending a training to help others community in a disaster (R=0.61). Talking with a neighbor about preparedness (R=0.34), having a 3-day supply of water (R=0.26), having a household plan to reunite (R=0.48), buying additional emergency supplies (R=0.23), working or volunteering to help respond to a disaster (R=0.34), and attending a psychological first aid training (R=0.24) possessed more moderate correlations. The smallest correlation was for the measure of attending a community meeting where preparedness was discussed (R=0.18). This variate could therefore best be summarized as a measure of preparedness with the greatest emphasis on looking for information about preparedness, attending community preparedness trainings, and having a 3-day supply of non-perishable food.

**Table 5.14** Correlation between preparedness canonical variate and preparedness variables, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Variables | Preparedness variate |
|---|---|
| Talked with a neighbor about preparedness | 0.34 |
| Looked for information regarding preparedness | 0.64 |
| Has 3-day supply of water | 0.26 |
| Has 3-day supply of food | 0.59 |
| Has household plan to reunite | 0.48 |
| Attended training (e.g. CPR, first aid) to help others in community during a disaster | 0.61 |
| Attended a community meeting discussing preparedness | 0.18 |
| Bought additional emergency supplies | 0.23 |
| Worked or volunteer to help neighborhood prepare or respond to disaster | 0.34 |
| Attended psychological first aid training | 0.24 |

Upon examining the correlations of the set of independent disability measures on the canonical variate derived from the preparedness variables (Table 5.15), one trend stood out. The self-rated health variable possessed the largest negative associated with the preparedness variate (R=-0.16), though the overall correlation was moderate. Because this variable had a medium to high positive correlation with all the preparedness variables, this finding suggests that worse self-rated health is most negatively associated with participating in most preparedness behaviors, with a particular emphasis on looking for information about preparedness, attending community preparedness trainings, and having a 3-day supply of non-perishable food. The correlations of each of the preparedness variables on the canonical variate derived from the disability variables (Table 5.16) also suggests this trend. Looking for information about getting preparedness for a disaster (R=0.10), having a 3-day supply of non-perishable food (R=0.10), and attending a training to help community in a disaster (R=0.10) possessed the highest correlations with the disability canonical variate. As described earlier, the first disability variate was characterized as being negatively correlated with all disability variables, with a particularly strong correlation

with worse self-rated health, a medium-high correlation with activity limitations, and medium-low correlations with the remaining two variables. While regression models previously demonstrated that participating in disaster preparedness behaviors was negatively associated with both worse self-rated health and activity limitations, the canonical correlation analysis further suggests that this relationship is most strongly driven by looking for information about preparedness, possessing a 3-day supplies of non-perishable food, and attending a training (e.g. CPR) to help community in a disaster.

**Table 5.15** Correlation between preparedness canonical variate and disability variables, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Variables | Preparedness variate |
|---|---|
| Worse self-rated health | -0.16 |
| Limited in activities from physical, mental, or emotional problems | -0.07 |
| Presence of health problem requiring use of special medical equipment | -0.05 |
| Consider yourself a person with a disability | -0.04 |

**Table 5.16** Correlation between disability canonical variate and preparedness variables, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Variables | Disability variate |
|---|---|
| Talked with a neighbor about preparedness | 0.05 |
| Looked for information regarding preparedness | 0.10 |
| Has 3-day supply of water | 0.04 |
| Has 3-day supply of food | 0.10 |
| Has household plan to reunite | 0.08 |
| Attended training (e.g. CPR, first aid) to help others in community during a disaster | 0.10 |
| Attended a community meeting discussing preparedness | 0.03 |
| Bought additional emergency supplies | 0.04 |
| Worked or volunteer to help neighborhood prepare or respond to disaster | 0.06 |
| Attended psychological first aid training | 0.04 |

In summary, the results provide evidence supporting the focal relationship that disability is negatively associated with disaster preparedness. While two of the regression models yielded

non-significant results, the cross tabulations suggest that these may be more extreme measures of the disability construct and may therefore be weaker to study in this context. Canonical correlation analysis also provided evidence that self-rated health possesses the strongest correlation with disaster preparedness. This disability measure will therefore be the most informative independent variable in subsequent analyses. Furthermore, three disaster preparedness behaviors appeared to be driving the focal relationship. Looking for information about preparedness, possessing a 3-day supplies of non-perishable food, and attending a training (e.g. CPR) to help the community in a disaster were most strongly correlated with the disability canonical correlation variate. Although I will still treat preparedness as a 10-item index in later analyses in order to successfully run hierarchical linear regression on a continuous outcome, I will use these descriptive results to better interpret the findings.

Chapter 6. Results: Intrapersonal Mediators of Disability and Preparedness

The results from the previous chapter suggest that possessing a disability or ailment that limits activities may reduce one's likelihood of participating in different disaster preparedness behaviors. To get these more vulnerable individuals better prepared for disasters, it is crucial that we understand what factors are contributing to lower levels of preparedness. Mediation analysis is a useful tool for identifying potential pathways that can explain the focal relationship. By identifying mediators to preparing for disasters, public health policy and programming can target preparedness barriers among people with disabilities and better influence their behavior.

**Overview of Hypotheses and Methods**

This chapter presents the results from the mediation analyses using three intrapersonal variables as mediators: self-efficacy, general response efficacy, and collective response efficacy. These analyses coincide with the hypotheses for RQ2 and RQ3. The hypotheses associated with RQ2 propose that H2.1) disability is negatively associated with self-efficacy, H2.2) self-efficacy is positively associated with disaster preparedness, and H2.3) self-efficacy mediates the relationship between disability status and disaster preparedness behaviors. The hypotheses associated with RQ3 propose that H3.1) disability is negatively associated with response efficacy, H3.2) response efficacy is positively associated with disaster preparedness, and H3.3) response efficacy mediates the relationship between disability status and disaster preparedness behaviors.

To test these hypotheses, I followed Baron and Kenney's Product Method. This method involves four steps where one establishes a statistically significant relationship between the independent and dependent variable (step 1), between the independent variable and the mediator (step 2), and between the mediator and the dependent variable (step 3). Then, one tests the

relationship between the independent variable and the dependent variable after controlling for the mediator (step 4). For models that provided evidence of mediation through the mediation analysis steps, I then conducted a Sobel test to determine if the mediation coefficient was statistically significant.

I conducted the mediation analysis steps separately for each of the four disability measures, which were my main independent variables. The disaster preparedness index was the main dependent variable. To test H2.1-H2.3, I used self-efficacy as the mediator. For the response efficacy mediators which tested H3.1-H3.3, two variables were tested separately as they represent distinct measures that could not be reliably combined into one index. The general response efficacy asked respondents about their level of agreement with "I don't think it really matters if you plan for disaster such as a major earthquake." The second measure focused more on perceptions of collective efficacy and asked respondents about their level of agreement with "planning with my neighbors now won't help my household after an earthquake or other major disaster."

**Self-Efficacy Mediation**

As described in the methods chapter, I conducted the four steps of Baron and Kenney's Product Method in order to establish whether self-efficacy mediates the relationship between disability and disaster preparedness (Figure 6.1)

Figure 6.1 Mediation Diagram Based on Baron & Kenny's (1986) Product Method

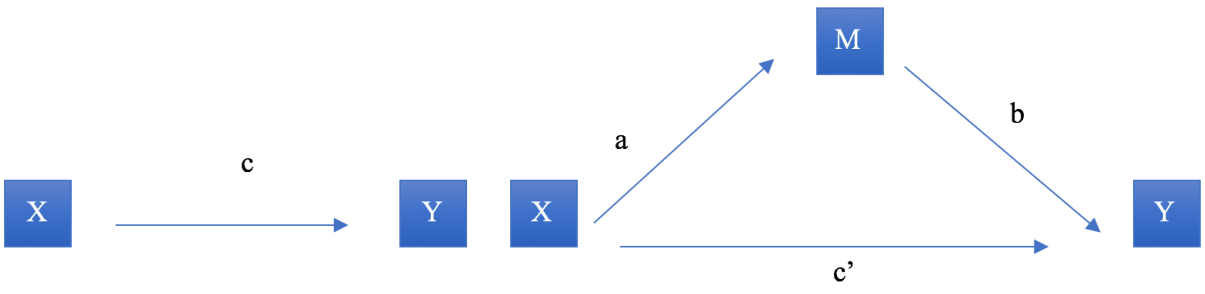


Table 6.1 provides the coefficients generated for each of these steps using self-rated health as the focal independent variable. In each of the models, age, gender, and race/ethnicity were included as covariates. There was also a random intercept to account for multilevel structure of the data. As previously presented in chapter 5, there was a statistically significant negative direct relationship (path c) between self-rated health and disaster preparedness (B=-0.2314, $p<0.001$). Next, when self-efficacy was regressed on worse self-rated health (path a), there was a statistically significant negative association (B=-0.2499, $p<0.001$). This confirms H2.1, which states that there is an inverse relationship between disability status and self-efficacy so that living with disabilities is negatively associated with self-efficacy for disaster preparedness in comparison to those who do not have disabilities. In the final model, which accounts for step 3 (path b) and step 4 (path c'), preparedness was regressed on both self-efficacy and self-rated health. Self-efficacy was significantly positively associated with engaging in preparedness behaviors (path b) (B=0.5806, $p<0.001$). This finding confirms H2.2, which states that there is a direct association between self-efficacy and disaster preparedness so that self-efficacy for disaster preparedness is positively associated with participation in disaster preparedness behaviors. Finally, the coefficient for worse self-rated health (path c') remained negative and statistically significant after controlling for self-efficacy, but was reduced in magnitude (B=-0.0823, $p=0.043$). This suggests that partial mediation is occurring, though confirmation of the mediation hypothesis (H2.3) will follow when results from the Sobel test are presented.

**Table 6.1** Mediation analysis of self-efficacy on the relationship between worse self-rated health and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Worse self-rated health | -0.2314 (p<0.001) | -0.2499 (p<0.001) | 0.5806 (p<0.001) | -0.0823 (p=0.043) |

[a]Controlling for gender, age, and race/ethnicity

Table 6.2 presents the results of the self-efficacy mediation analysis using activity limitations as the focal independent variable. As presented in chapter 5, there was a significant negative associated between activity limitations and disaster preparedness (path c) (B=-0.2294, p=0.035). In step 2, when self-efficacy was regressed activity limitations (path a), there was a statistically significant negative association between these two variables (B=-0.3221, p<0.001), confirming the H2.1. In the final steps, preparedness was regressed on both activity limitations and self-efficacy. As hypothesized (H3.2), self-efficacy was significant positively associated with engaging in disaster preparedness behaviors (B=0.5910, p<0.001). Adding self-efficacy to the model additionally reduced the negative relationship between activity limitations and preparedness that it became non-significant, suggesting that complete mediation is occurring. Again, confirmation of the mediation hypothesis (H2.3) will follow when the results from the Sobel test are presented.

**Table 6.2** Mediation analysis of self-efficacy on the relationship between activity limitations and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Limited in activities from physical, mental, or emotional problems | -0.2294 (p=0.035) | -0.3221 (p<0.001) | 0.5910 (<0.001) | -0.0624 (p=0.543) |

[a]Controlling for gender, age, and race/ethnicity

Self-efficacy mediation analysis was then conducted for the disability variable that assessed whether respondents required the use of special medical equipment as the main independent focal variable (Table 6.3). As demonstrated in chapter 5, this variable was not statistically significant on its own (path c) (B=-0.0897, p=0.437). Thus, in order for mediation to be occurring, there would have to be evidence of suppression occurring by the mediator. When self-efficacy was regressed on requiring the use of special medical equipment, there was in fact a significant negative association for path a (B=-0.3313, p<0.001), supporting H2.1. Additionally, the third model that regressed preparedness on both self-efficacy and requiring the use of special medical equipment determined that self-efficacy was positively significantly associated with preparedness (path b) (B=0.6002, p<0.001), confirming H2.2. However, the direct relationship between requiring the use of special medical equipment and preparedness (path c') was neither statistically significant nor negative in direction (B=0.0742, p=0.487). These findings do not provide evidence of suppression and thus reject the self-efficacy mediation hypothesis (H2.3) for this variable.

**Table 6.3** Mediation analysis of self-efficacy on the relationship between requiring the use of special medical equipment and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Presence of health problem requiring use of special medical equipment (e.g. cane, wheelchair, special bed, or a special telephone) | -0.0897 (p=0.437) | -0.3313 (p<0.001) | 0.6002 (p<0.001) | 0.0742 (p=0.487) |

[a]Controlling for gender, age, and race/ethnicity

Finally, self-efficacy mediation analysis was conducted for the focal independent variable that asked respondents whether they considered themselves a person with a disability (Table 6.4). Again, the previous chapter found that the total effect (path c) between the focal variables

was non-significant (B=-0.0089, p=0.944), so suppression had to be occurring in order for mediation to be significant. When self-efficacy was regressed on considering yourself a person with a disability (path a), the relationship was statistically significant and negative (B=-0.3810, p<0.001), confirming H2.1. The model where preparedness was regressed on both self-efficacy and considering yourself a person with a disability (steps 3 & 4), additionally supported H2.2, as self-efficacy was significantly positively associated with engaging in disaster preparedness behaviors (path b) (B=0.6047, p<0.001). Nevertheless, the direct relationship between disability and preparedness (path c') was both non-significant and positive in direction (B=0.2111, p=0.116), providing no evidence that self-efficacy is significantly mediating the negative relationship between the focal variables. H2.3 is therefore rejected for this variable.

**Table 6.4** Mediation analysis of self-efficacy on the relationship between considering yourself a person with a disability and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Consider yourself a person with a disability | -0.0089 (p=0.944) | -0.3814 (p<0.001) | 0.6047 (p<0.001) | 0.2111 (p=0.116) |

[a]Controlling for gender, age, and race/ethnicity

To estimate the indirect effect of self-efficacy on the relationship between disability and preparedness for the self-rated health and activity limitation variables, point estimates for the mediation coefficients were calculated by multiplying the a and b pathways for each set of analyses. Results from the Sobel tests evaluating whether these effects were significant are located in Table 6.5. For self-rated health, there was significant partial mediation occurring, with self-efficacy contributing to an indirect effect of -0.1451 (p<0.001). The indirect effect for activity limitations, however, was non-significant, suggesting that self-efficacy does not mediate

the relationship between possessing activity limitations and engaging in disaster preparedness behaviors.

**Table 6.5** Coefficient estimates for mediation of self-efficacy on the relationship between disability and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| Independent variable | Mediation coefficient estimate (SE)[b] | p value |
|---|---|---|
| Worse self-rated health (continuous) | -0.1451 (0.0179) | <0.001 |
| Limited in activities from physical, mental, or emotional problems | -0.1904 (0.0422) | 1.00 |

[a]Controlling for gender, age, and race/ethnicity
[b]SE=Standard Error

**General Response Efficacy Mediation**

The next set of mediation analyses were conducted for each of the four disability measures and the general response efficacy variable as the mediator. Results from the mediation analysis using self-rated health are located in Table 6.6. The significant negative coefficient for path c, the total effect between these two variables, was previously presented in chapter five as well as for the self-efficacy mediation analysis (B=-0.2314, p<0.001). For step 2, when general response efficacy was regressed on worse self-rated health (path a), there was a significant negative association (B=-0.0640, p<0.001), confirming H3.1. For steps 3 and 4, when preparedness was regressed on both general response efficacy and self-rated health, response efficacy (path b) was positively associated with preparedness (B=-.2076, p=0.009), supporting H3.2. The negative relationship between worse self-rated health and preparedness also remained statistically significant but was smaller in magnitude (-0.2168, p<0.001), suggesting that partial mediation is occurring. Confirmation of the mediation hypothesis (H3.3) will follow when results from the Sobel test are presented.

**Table 6.6** Mediation analysis of general response efficacy on the relationship between worse self-rated health and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Worse self-rated health | -0.2314 (p<0.001) | -0.0640 (<0.001) | 0.2076 (p=0.009) | -0.2168 (p<0.001) |

[a]Controlling for gender, age, and race/ethnicity

Table 6.7 presents the results of the mediation analysis of general response efficacy on the relationship between activity limitations and disaster preparedness. As previously described, the total effect of activity limitations on preparedness (path c) was statistically significant and negative (B=-0.2294, p=0.035). For step 2, when general response efficacy was regressed on activity limitations (path a), the association was non-significant (B=-0.0131, p=0.662), rejecting H3.1 for this model. While general response efficacy was still positively associated with preparedness (path b) (B=0.2306, p=0.004) as hypothesized by H3.2, the fact that it was not significantly associated with activity limitations suggests that no mediation can be occurring, rejecting H3.3. Controlling for general response efficacy, possessing activity limitations was still significantly negatively associated with engaging in disaster preparedness behaviors (path c') (B=-0.2290, p=0.037).

**Table 6.7** Mediation analysis of general response efficacy on the relationship between activity limitations and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Limited in activities from physical, mental, or emotional problems | -0.2294 (p=0.035) | -0.0131 (p=0.662) | 0.2306 (p=0.004) | -0.2290 (p=0.037) |

[a]Controlling for gender, age, and race/ethnicity

Table 6.8 presents the results of the general response efficacy mediation analysis with having a health problem requiring the use of medical equipment as the main focal independent

variable. Again the earlier analyses found that the total effect between the focal variables (path c) was non-significant (B=-0.0897, p=0.439). Thus, the only way that mediation could be significant would be if suppression were occurring. For step 2, when general response efficacy was regressed on requiring the use of medical equipment (path b), the results were non-significant, rejecting H3.1 and refuting any claims of suppression. When preparedness was regressed on requiring the use of medical equipment and general response efficacy (path b), general response efficacy was positively associated with preparedness (B=0.2359, p=0.004), as hypothesized by H3.2. However, because requiring the use of medical equipment was not associated with general response efficacy and the fact that this focal independent variable remained non-significant in the model with response efficacy (B=-0.0708, p=0.558), the mediation hypothesis (H3.3) is rejected.

**Table 6.8** Mediation analysis of general response efficacy on the relationship between requiring the use of special medical equipment and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Presence of health problem requiring use of special medical equipment (e.g. cane, wheelchair, special bed, or a special telephone) | -0.0897 (p=0.439) | 0.0451 (p=0.135) | 0.2359 (p=0.004) | -0.0708 (p=0.558) |

[a]Controlling for gender, age, and race/ethnicity

The results of the general response efficacy mediation analysis with considering yourself a person with a disability as the main focal independent variable are located in Table 6.9. As previously described, the total effect of this disability measure on preparedness (path c) was non-significant (B=-0.0897, p=0.439). In step 2, when general response efficacy was regressed on considering yourself a person with a disability, the negative association was significant (B=-

0.727, p=0.045), confirming hypothesis H3.1. For step 3, when preparedness was regressed on both predictors, general response efficacy was positively associated with preparedness (path b) (B=0.2340, p=0.005), supporting H3.2. Nevertheless, requiring the use of medical equipment remained non-significant, refuting the suppression claim. General response efficacy therefore does not mediate the relationship between considering yourself a person with a disability and preparedness, rejecting H3.3 for this variable.

**Table 6.9** Mediation analysis of general response efficacy on the relationship between considering yourself a person with a disability and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Consider yourself a person with a disability | -0.0089 (p=0.944) | -0.0727 (p=0.045) | 0.2340 (p=0.005) | 0.0160 (p=0.903) |

[a]Controlling for gender, age, and race/ethnicity

As self-rated health was the only independent variable whose mediation analysis suggested that mediation is occurring, a point estimate for the mediation coefficient was calculated by multiplying the a and b pathways from its mediation analysis steps. Results from the Sobel test (Table 6.10) determined that the mediation of general response efficacy on the relationship between self-rated health and engaging in disaster preparedness was non-significant (B=-0.0133, p=0.994), rejecting H3.3.

**Table 6.10** Coefficient estimates for mediation of general response efficacy on the relationship between disability and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Mediation coefficient estimate (SE[b])** | **p value** |
|---|---|---|
| Worse self-rated health | -0.0133 (0.006) | 0.994 |

[a]Controlling for gender, age, and race/ethnicity
[b]SE=Standard error

**Collective Response Efficacy Mediation**

The next set of mediation analyses assessed whether perceptions of collective response efficacy mediates the relationship between disability and preparedness. Table 6.11 presents the results of the mediation analysis of collective response efficacy on the relationship between worse self-rated health and disaster preparedness. As previously presented, the step 1 coefficient (path c) was statistically significant (B=-0.2314, p<0.001), demonstrating that worse self-rated health was negatively associated with engaging in disaster preparedness. The next step, which involved regressing collective response efficacy on self-rated health (path a), supported H3.1, as there was a statistically significant and negative association between these two variables (B=-0.0273, p=0.007). In the following step, when preparedness was regressed on both collective response efficacy and self-rated health (path b), there was a significant positive association between collective response efficacy and disaster preparedness, confirming H3.2. Finally, this same model found that the relationship between worse self-rated health and preparedness (path c') remained both negative and significant (B=-0.220, p<0.001). The coefficient reduced in magnitude after controlling for the mediator, suggesting that collective efficacy is contributing to partial mediation. Confirmation of the mediation hypothesis (H3.3) will follow when results from the Sobel test are presented.

**Table 6.11** Mediation analysis of collective response efficacy on the relationship between worse self-rated health and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Worse self-rated health | -0.2314 (p<0.001) | -0.0473 (p=0.007) | 0.1439 (p=0.042) | -0.2220 (p<0.001) |

[a]Controlling for gender, age, and race/ethnicity

Table 6.12 presents the results of the collective response efficacy mediation analysis between activity limitations and disaster preparedness. As previously described, the total effect of activity limitations on preparedness (path c) was statistically significant and negative (B=-0.2294, p=0.035). Similar to the earlier results with general response efficacy, the results also determined that collective response efficacy was not significantly associated with activity limitations (path a) (B=0.0082, p=0.810), rejecting H3.1. In the third model of preparedness regressed on both the mediator and activity limitations, there was a significant positive association between collective response efficacy and preparedness (B=0.1490, p=0.032), supporting H3.2. The focal relationship also reduced in magnitude and became non-significant; however, because possessing activity limitations was not associated with collective response efficacy, the mediation hypothesis (H3.3) is rejected again.

**Table 6.12** Mediation analysis of collective response efficacy on the relationship between activity limitations and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Limited in activities from physical, mental, or emotional problems | -0.2294 (p=0.035) | 0.0082 (p=0.810) | 0.1490 (p=0.032) | -0.2154 (0.058) |

[a]Controlling for gender, age, and race/ethnicity

The results from the mediation analysis of collective response efficacy on the relationship between having a health problem that requires the use of special medical equipment and disaster preparedness are located in Table 6.13. Mirroring the results from the mediation analysis with general response efficacy, H3.1 and H3.3 are rejected, as requiring the use of special medical equipment was neither significantly associated with collective response efficacy mediator (path a) (B=-0.0204, p=0.580) nor with the preparedness outcome after controlling for the mediator

(path c') (B=-0.0613, p=0.603). Suppression is therefore not occurring. Path b, however, was statistically significant, with collective response efficacy positively associated with disaster preparedness (B=0.1638, p=0.024), supporting H3.2 for this variable.

**Table 6.13** Mediation analysis of collective response efficacy on the relationship between requiring the use of special medical equipment and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| **Independent variable** | **Beta coefficient (p value)** | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Presence of health problem requiring use of special medical equipment (e.g. cane, wheelchair, special bed, or a special telephone) | -0.0897 (p=0.437) | -0.0204 (p=0.580) | 0.1638 (0.024) | -0.0613 (p=0.603) |

[a]Controlling for gender, age, and race/ethnicity

Table 6.14 presents the results from the final mediation analysis of collective response efficacy on the relationship between considering yourself a person with a disability and disaster preparedness. As previously described, the total effect of this disability measure on preparedness (path c) was non-significant (B=-0.0899, p=0.944). Suppression can also not be occurring as there was a non-significant relationship between the considering yourself a person with a disability variable and both the response efficacy mediator (path a) (B=-0.0309, p=0.423) and the preparedness outcome after controlling for the mediator (path c') (B=0.0330, p=0.798). Both hypotheses H3.1 and H3.3 are therefore rejected. Only H3.2 (path b) is supported as there was a positive association between collective response efficacy and disaster preparedness (B=0.1614, p=0.026).

**Table 6.14** Mediation analysis of collective response efficacy on the relationship between considering yourself a person with a disability and disaster preparedness from multivariable hierarchical linear regression, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| Independent variable | Beta coefficient (p value) | | | |
|---|---|---|---|---|
| | Step 1 (c) | Step 2 (a) | Step 3 (b) | Step 4 (c') |
| Consider yourself a person with a disability | -0.0089 (p=0.944) | -0.0309 (p=0.432) | 0.1614 (p=0.026) | 0.0330 (p=0.798) |

[a]Controlling for gender, age, and race/ethnicity

As with the previous response efficacy mediation analyses, only self-rated health provided evidence of mediation occurring. Results from the product estimate and Sobel test for this mediation coefficient are located in Table 6.15. Again the mediation coefficient was non-significant (B=-0.0068, p=0.948), rejecting H3.3 for this variable.

**Table 6.15** Coefficient estimates for mediation of collective response efficacy on the relationship between disability and disaster preparedness from multivariable hierarchical linear regression analysis, Public Health Response to Emergent Threats Survey 2013 (n=4700)[a]

| Independent variable | Mediation coefficient estimate (SE) | p value |
|---|---|---|
| Worse self-rated health | -0.0068 (0.004) | 0.948 |

[a]Controlling for gender, age, race/ethnicity, and community
[b]SE=Standard error

In summary, the results from the mediation analyses only found that self-efficacy was a significant partial mediator of the negative relationship between worse self-rated health and engaging in disaster preparedness behaviors. People with lower self-rated health therefore perceive themselves to have lower efficacy regarding the ability to participate in disaster preparedness behaviors, which partially contributes to their lower engagement in these behaviors.

Neither perceptions of general response efficacy nor collective response efficacy were significant mediators, suggesting that the response efficacy construct may be less important to

the relationship between disability and preparedness. I additionally combined these individual variables into one measure to assess whether it was a stronger measure that could contribute to mediation, but the results remained unchanged (results not presented). Despite the null mediation findings, response efficacy does appear to be directly associated with disaster preparedness, even after controlling for disability status, age, gender, and race/ethnicity. Intrapersonal perceptions regarding the effectiveness of preparedness behaviors in protecting against the harm of disasters is thus an important correlate to engaging in these behaviors, but does not explain the relationship for people with disabilities.

Two of the disability variables, having a health problem requiring the use of special medical equipment and considering yourself to be a person with a disability, did not possess statistically significant associations with the disaster preparedness outcome even after controlling for potential mediators. Because the suppression argument was rejected, it appears that there may not be a relationship between either of these two variables and the outcome. Interpretations of these findings will be further discussed Chapter 8. Nevertheless, the lack of significant associations indicates that I should no longer be studying these variables as I test the remaining hypotheses. Only self-rated health and activity limitations will be included in the analyses presented in the following chapter.

Chapter 7. Results: Social and Environmental Moderators of Disability and Preparedness

One's social connections and surrounding environment have a large influence on their behavior. These factors can provide people with disabilities with important information, norms, and resources that can potentially change how their functional and health limitations influence preparing for disasters. With limited research in this area, we need to better identify what aspects of one's surroundings affect the relationship between disability and preparedness and can ultimately worsen or alleviate their greater vulnerability to disasters.

**Overview of Hypotheses and Methods**

This chapter evaluates whether different social and environmental factors moderate the relationship between disability and disaster preparedness. The moderators included perceived neighborhood social capital (H4.1), community social vulnerability (H5.1), community advantage (H6.1), and community wildfire risk (H7.1). Social capital is an individual-level variable relating to perceptions of neighborhood connections collected by the PHRETS survey. The three latter community variables were aggregated from publically available datasets at the census tract level. These level 2 variables represent characteristics of the 16 communities in which individuals were clustered.

Hypotheses H4.1 through H7.1 were tested by including each of these variables and its interaction with the disability measure in separate hierarchical linear regression models that test the focal relationship. Only the models that contained self-rated health and activity limitations as the main independent variable were tested, as earlier results suggest that the two other disability variables were not associated with the preparedness outcome.

The first hypothesis, H4.1, proposes that perceived neighborhood social capital moderates the association between disability status and disaster preparedness so that when social

capital is high, the negative relationship between disabilities and preparedness is weaker; conversely, when perceived social capital is low the negative relationship between disabilities and preparedness is stronger. A significant positive interaction term was needed to support this hypothesis.

The next hypothesis, H5.1, proposes that social vulnerability moderates the association between disability status and disaster preparedness so that when social vulnerability is high, the negative relationship between disabilities and preparedness is stronger; conversely, when vulnerability is low, the negative relationship between disabilities and preparedness is weaker. Social vulnerability was measured using community-level SVI percentile rankings. To confirm H5.1, the coefficient for the interaction term would have to be negative and statistically significant.

The next hypothesis, H6.1, proposes that community advantage moderates the association between disability status and disaster preparedness so that when advantage is high, the negative relationship between disabilities and preparedness is weaker; conversely, when advantage is low, the negative relationship between disabilities and preparedness is stronger. Community advantage was measured using the community-level HPI percentile rankings. H6.1 was supported if the coefficient for the interaction term was positive and statistically significant.

Furthermore, I assessed whether community-level wildfire risk moderates the focal relationship. H7.1 hypothesizes that wildfire risk moderates the association between disability status and disaster preparedness so that when risk is high, the negative relationship between disabilities and preparedness is weaker; conversely, when risk is low, the negative relationship between disabilities and preparedness is stronger. If the interaction coefficient was significant and positive, H7.1 was supported.

Each of the models also controlled for individual gender, age, and race/ethnicity, and included an intercept error term to account for the multilevel structure to the data. While self-efficacy and response efficacy were previously shown to be associated with the preparedness outcome, they were not controlled for in the moderation models due to issues with overfitting. As demonstrated in Chapter 5, the intraclass correlation coefficients were low, so including additional level 1 variables would over control for level 2 variance. When the moderation models included additional level 1 predictors (results not shown), the models were not robust enough to maintain significant interaction findings. I therefore decided to run each moderation model separately and without additional individual-level covariates beyond age, gender and race/ethnicity.

For models that included a level 2 predictor (i.e. those that test H5.1, H6.1 and H7.1), I also added an error term for the slope. If the variance of the slope was non-significant, it was removed from the model and a non-varying slope model was used to evaluate the hypothesis.

If either of the composite multi-item indexes (SVI or HPI) was a significant moderator, then I additionally conducted analyses using the individual domains to assess which of the overall index's domains were driving the results.

Finally, individual and community-level weights were applied to each of the models to enhance representativeness of the sample.

**Social Capital Moderation**

Social capital was measured by asking PHRETS survey respondents "About how many people in your neighborhood do you know well enough to ask for a favor?" This was a level 1 predictor, so only a non-randomly varying slope multilevel model was assessed (i.e. only error term for intercept). Results from the moderation model with self-rated health on preparedness are

located in Table 7.1. In comparison to the social capital*excellent health interaction term, the social capital interaction terms with very good health (B=-0.2997, p=0.457), good health (B=0.1157, p=0.830), fair health (B=-0.4343, p=0.312), and poor health (B=-0.3892, p=0.598) all possessed non-significant beta coefficients. H4.1 is therefore rejected.

However, as an individual predictor, social capital was significantly positively associated with preparedness (B=0.6589, p<0.001). When the self-rated health model was rerun without the interaction term (Appendix C), social capital was still significantly positively associated with preparedness (B=0.6257, p<0.001). Individuals who knew more people in their neighborhood who they could turn to for a favor were therefore associated with participating in a greater number of preparedness behaviors.

Results from the social capital moderation model with activity limitations on preparedness are located in Table 7.2. As with self-rated health, the social capital*presence of activity limitations interaction term was non-significant (B=0.0230, p=0.802), rejecting H4.1. As an individual covariate, social capital was significantly positively associated with preparedness (B=0.6354, p<0.001). When the non-significant interaction term was removed from the model (Appendix C), social capital was still significantly positively associated with preparedness (B=0.6395, p<0.001).

**Table 7.1** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with social capital interaction, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.3892 | 0.598 |
| Fair | -0.4343 | 0.312 |
| Good | 0.1157 | 0.830 |
| Very good | -0.2997 | 0.457 |
| Excellent (reference) | -- | -- |
| Social capital | 0.6589 | <0.001 |
| Self-rated health * social capital | | |
| Poor * social capital | -0.0601 | 0.824 |
| Fair * social capital | -0.0372 | 0.807 |
| Good * social capital | -0.1872 | 0.389 |
| Very good * social capital | 0.1053 | 0.537 |
| Excellent (reference) * social capital | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2256 | 0.010 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.1318 | 0.322 |
| 45-59 | 0.2677 | 0.057 |
| 60+ | 0.3959 | 0.014 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.2267 | 0.103 |
| Asian | -0.2971 | 0.191 |
| Hispanic | 0.0910 | 0.442 |
| Other | 0.2614 | 0.345 |

**Table 7.2** Multivariable hierarchical linear regression analysis of disaster preparedness on activity limitations with social capital interaction, Public Health Response to Emergent Threats Survey 2013 (n=4700)

| Independent variable | Standardized beta coefficient | p value |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.2525 | 0.273 |
| No (reference) | -- | -- |
| Social capital | 0.6354 | <0.001 |
| Presence of activity limitations * social capital | | |
| Yes * social capital | 0.0230 | 0.802 |
| No * social capital (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2259 | 0.010 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.1287 | 0.304 |
| 45-59 | 0.2369 | 0.075 |
| 60+ | 0.3661 | 0.009 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.2137 | 0.164 |
| Asian | -0.3177 | 0.173 |
| Hispanic | 0.0428 | 0.693 |
| Other | 0.2924 | 0.275 |

**Community Social Vulnerability Moderation**

Results from the model where community-level social vulnerability was included as an individual covariate and as an interaction term with self-rated health are located in Table 7.3. When an error term for the slope was included it was non-significant (p=0.739), so the results presented are from the non-varying slope model. In comparison to the social vulnerability*excellent health interaction term, the social vulnerability interaction terms with very good health (B=-0.0027, p=0.348), good health (B=0.0056, p=0.267), fair health (B=0.0010, p=0.835), and poor health (B=-0.0141, p=0.065) were all not statistically significant. H5.1 is thus rejected. When the model was rerun without the interaction term but including

social vulnerability as an individual covariate, it still did not possess a significant association with preparedness (B=-0.0003, p=0.943) (Appendix D). This suggests potential measurement issues with SVI which will be discussed later.

**Table 7.3** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with social vulnerability interaction, Public Health Response to Emergent Threats Survey 2013, Social Vulnerability Index (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | 0.2778 | 0.581 |
| Fair | -0.7550 | 0.017 |
| Good | -0.8034 | 0.018 |
| Very good | -0.0899 | 0.684 |
| Excellent (reference) | -- | -- |
| Social vulnerability | -0.0009 | 0.855 |
| Self-rated health * social vulnerability | | |
| Poor * social vulnerability | -0.0141 | 0.065 |
| Fair * social vulnerability | 0.0010 | 0.835 |
| Good * social vulnerability | 0.0056 | 0.267 |
| Very good * social vulnerability | -0.0027 | 0.348 |
| Excellent (reference) * social vulnerability | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.3052 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0650 | 0.604 |
| 45-59 | 0.2913 | 0.041 |
| 60+ | 0.4220 | 0.006 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1311 | 0.359 |
| Asian | -0.3308 | 0.104 |
| Hispanic | 0.1054 | 0.427 |
| Other | 0.2112 | 0.426 |

Table 7.4 presents the results from the model where community-level social vulnerability was included as an individual covariate and as an interaction term with activity limitations. Mirroring the previous model, the slope's variance was non-significant (p=0.218), so the results presented are for the non-randomly varying slope model. Again, H5.1 is rejected, as social

vulnerability was not a significant moderator of activity limitations and preparedness (B=-0.0021, p=0.642). When the non-significant interaction term was removed from the model and social vulnerability was included as an individual covariate, it was still not statistically significantly associated with preparedness (B=-0.0025, p=0.534) (Appendix D).

**Table 7.4** Multivariable hierarchical linear regression analysis of disaster preparedness on activity limitations with social vulnerability interaction, Public Health Response to Emergent Threats Survey 2013, Social Vulnerability Index (n=4700)

| Independent variable | Standardized beta coefficient | p value |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.0735 | 0.783 |
| No (reference) | -- | -- |
| Social vulnerability | -0.0021 | 0.621 |
| Presence of activity limitations * social vulnerability | | |
| Yes * social vulnerability | -0.0021 | 0.642 |
| No * social vulnerability (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2908 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0424 | 0.701 |
| 45-59 | 0.2113 | 0.107 |
| 60+ | 0.3201 | 0.011 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1499 | 0.345 |
| Asian | -0.3849 | 0.062 |
| Hispanic | 0.0186 | 0.881 |
| Other | 0.2510 | 0.324 |

**Community Advantage Moderation**

This next section presents results from the analyses of community advantage as a moderator of disability on its relationship with disaster preparedness. While not originally included in this dissertation's conceptual model, community advantage was later added as a variable to further explore how social and environmental measures of community

vulnerability/advantage influence disaster preparedness. Besides possessing a positive valence where higher scores mean less vulnerability or greater advantage, the Healthy Places Index also contains a number of additional indicators that help differentiate it from the Social Vulnerability Index. Examples of these other measures include percent of population with health insurance, presence of environmental pollutants, access to green spaces and grocery stores, and political engagement. Additionally, the HPI rankings are across the state of California whereas SVI uses a national ranking method. When the SVI moderation hypotheses were rejected for both the self-rated health and activity limitations models, it was hypothesized that this might be due to lack of variation between the study communities, as neighborhoods in Los Angeles County might be more similar when ranked against national census tracts. Because HPI is ranked within the state, there is greater variation at the local level, strengthening the ability to assess this community-level measure as a moderator.

Results from the model assessing community advantage as a moderator of self-rated health on its relationship with disaster preparedness are located in Table 7.5. The variance component was non-significant when I added an error term for the slope (p=0.722), so the results presented are for a non-varying slope model. In comparison to the community advantage*excellent health interaction term, the community advantage interaction terms with very good health (B=-0.0010, p=0.783), good health (B=-0.0070, p=0.145), and fair health (B=-0.0021, p=0.680) were not statistically significant. However, the interaction term for poor self-rated health*community advantage was positive and significant (B=0.0155, p=0.025), providing evidence in support of H6.1. The interaction term represents the change in slope for self-rated health with increasing community advantage. All else equal, for every one unit increase in community advantage, individuals with poor self-rated health participated in a mean increase of

0.0155 disaster preparedness behaviors. As the direct relationship between poor self-rated health and disaster preparedness was negative (B=-1.3229, p<0.001), living in a community that had one HPI percentile rank higher (i.e. more advantaged) reduced the magnitude of that coefficient by 0.0155, significantly attenuating the negative focal relationship.

**Table 7.5** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with community advantage interaction, Public Health Response to Emergent Threats Survey 2013, Healthy Places Index (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -1.3229 | <0.001 |
| Fair | -0.6055 | 0.021 |
| Good | -0.1532 | 0.519 |
| Very good | -0.0484 | 0.746 |
| Excellent (reference) | -- | -- |
| Community advantage | 0.0020 | 0.654 |
| Self-rated health * community advantage | | |
| Poor * community advantage | 0.0155 | 0.025 |
| Fair * community advantage | -0.0021 | 0.680 |
| Good * community advantage | -0.0070 | 0.145 |
| Very good * community advantage | -0.0010 | 0.783 |
| Excellent (reference) * community advantage | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2869 | 0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0334 | 0.789 |
| 45-59 | 0.2578 | 0.070 |
| 60+ | 0.3791 | 0.013 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1699 | 0.233 |
| Asian | -0.3140 | 0.120 |
| Hispanic | 0.1004 | 0.443 |
| Other | 0.2660 | 0.315 |

Next, to assess what domains might be driving the community advantage moderation with self-rated health, I ran eight separate models with each of the HPI domains as an individual predictor and as an interaction term with self-rated health (Table 7.6). Results from the models

using the housing domain and the social domain contained statistically significant results. In particular, a one unit increase in the housing domain, which is comprised of items related to crowding, homeownership, cost burden of housing, and quality of housing, attenuated the negative relationship between poor self-rated health and preparedness by 0.0214 (p=0.002). The social domain, which contained a measure of percent of registered voters and percent of family homes with two parents, also possessed a positive interaction coefficient with poor self-rated health (B=0.0234, p<0.001). There was also a marginally significant interaction between poor self-rated health and the economy domain (B=0.012, p=0.052), the healthcare access domain (B=0.018, p=0.095), and the clean environment domain (B=0.029, p=0.07). None of the other domains were significant moderators, suggesting that a community's housing and social environment were mainly driving the moderation, with additional contribution from the economic, healthcare access, and clean environment domains.

Table 7.7 presents the results from the model assessing community advantage as a moderator of activity limitations on its relationship with disaster preparedness. Again, the variance component was non-significant when I added an error term for the slope (p=0.331), so the results presented are for a non-varying slope model. Results using the interaction term were non-significant (B=0.0051, p=0.281), rejecting the H6.1 for the activity limitations model. This mirrors the null results from the past mediation and moderation analyses, suggesting that this variable's relationship with disaster preparedness is weaker than that of self-rated health.

**Table 7.6** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with HPI[a] domain interactions, Public Health Response to Emergent Threats Survey 2013, Healthy Places Index (n=4700)

| | Economy | Education | Healthcare access | Housing | Neighborhood | Clean environment | Transportation | Social environment |
|---|---|---|---|---|---|---|---|---|
| **Independent variable** | **Standardized beta coefficient** | | | | | | | |
| Self-rated health | | | | | | | | |
| Poor | -1.286* | -1.238* | -1.417* | -1.478** | -0.574 | -1.429** | -1.170 | -1.521** |
| Fair | -0.641* | 0.858* | -0.665* | -0.765** | -1.058* | -0.604* | -1.236* | -0.864** |
| Good | -0.128 | -0.499 | -0.379 | -0.436† | -0.943* | -0.080 | -0.436 | -0.279 |
| Very good | -0.104 | -0.406* | -0.415* | -0.318* | -0.347 | 0.091 | -0.388 | -0.143 |
| HPI domain | 0.000 | -0.010* | -0.004 | -0.001 | -0.001 | 0.008 | -0.008 | 0.000 |
| Interaction | | | | | | | | |
| Poor*HPI domain | 0.012† | 0.010 | 0.018† | 0.021* | -0.005 | 0.020† | 0.008 | 0.023** |
| Fair*HPI domain | -0.001 | 0.003 | -0.002 | 0.001 | 0.010 | -0.003 | 0.127 | 0.005 |
| Good*HPI domain | -0.007 | 0.001 | -0.003 | -0.001 | 0.013 | -0.012 | -0.000 | -0.005 |
| Very Good*HPI domain | 0.000 | 0.007 | 0.008† | 0.006 | 0.007 | -0.006 | 0.006 | -0.001 |
| Gender | | | | | | | | |
| Female | -0.289** | -0.289** | -0.288** | -0.287** | -0.289** | -0.291** | -0.285** | -0.288** |
| Age | | | | | | | | |
| 30-44 | 0.051 | 0.049 | 0.032 | 0.033 | 0.038 | 0.040 | 0.031 | 0.048 |
| 45-59 | 0.288* | 0.289* | 0.252† | 0.254† | 0.250† | 0.251† | 0.264† | 0.290* |
| 60+ | 0.407* | 0.405* | 0.373* | 0.376* | 0.374* | 0.354* | 0.368* | 0.402* |
| Race/ethnicity | | | | | | | | |
| African American | 0.185 | 0.158 | 0.163 | 0.174 | 0.144 | 0.138 | 0.181 | 0.184 |
| Asian | -0.305 | -0.319 | -0.318 | -0.323 | -0.341† | -0.351† | -0.340† | -0.321 |
| Hispanic | 0.092 | 0.054 | 0.082 | 0.099 | 0.086 | 0.074 | 0.098 | 0.095 |
| Other | 0.251 | 0.258 | 0.267 | 0.251 | 0.262 | 0.268 | 0.265 | 0.250 |

[a]HPI=Health Places Index

†0.05<p<0.1, *p<0.05, **p<0.001

Note: Omitted reference categories: gender (male), age (18-29), race/ethnicity (white).

**Table 7.7** Multivariable hierarchical linear regression analysis of disaster preparedness on activity limitations with community advantage interaction, Public Health Response to Emergent Threats Survey 2013, Healthy Places Index (n=4700)

| Independent variable | Standardized beta coefficient | p value |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.4294 | 0.093 |
| No (reference) | -- | -- |
| Community advantage[a] | 0.0009 | 0.823 |
| Presence of activity limitations * community advantage | | |
| Yes * community advantage | 0.0051 | 0.281 |
| No * community advantage (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2896 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0397 | 0.718 |
| 45-59 | 0.2104 | 0.108 |
| 60+ | 0.3154 | 0.012 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1747 | 0.266 |
| Asian | -0.3611 | 0.081 |
| Hispanic | 0.0378 | 0.752 |
| Other | 0.2853 | 0.262 |

[a]Community Advantage measured by the Healthy Places Index percentile ranking for each community

**Community Wildfire Risk Moderation**

Table 7.8 presents the results from the multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with wildfire risk interaction. As with the previous models, the variance term for the slope was non-significant (p=0.999), so the results presented are for a non-randomly varying slope model. While the interaction terms between wildfire risk and the higher ratings of health were non-significant, the interaction term between poor self-rated health and wildfire risk was positive and statistically significant (B=0.0237, p=0.014), providing evidence in support of H7.1. All else equal, for every one unit increase in

wildfire risk, individuals with poor self-rated health participated in a mean increase of 0.0237 disaster preparedness behaviors. As the direct relationship between poor self-rated health and disaster preparedness was negative (-0.9171, p<0.001), belonging to a community where a greater percentage of population lives in a very high wildfire risk area reduced the magnitude of that coefficient by 0.0237, significantly reducing the negative focal relationship.

**Table 7.8** Multivariable hierarchical linear regression analysis of disaster preparedness on self-rated health with wildfire risk interaction, Public Health Response to Emergent Threats Survey 2013, Healthy Places Index (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.9171 | <0.001 |
| Fair | -0.6883 | <0.001 |
| Good | -0.3601 | 0.033 |
| Very good | -0.1316 | 0.291 |
| Excellent (reference) | -- | -- |
| Wildfire risk | 0.0069 | 0.132 |
| Self-rated health * wildfire risk | | |
| Poor * wildfire risk | 0.0237 | 0.014 |
| Fair * wildfire risk | 0.0015 | 0.830 |
| Good * wildfire risk | -0.0079 | 0.089 |
| Very good * wildfire risk | -0.0031 | 0.367 |
| Excellent (reference) * wildfire risk | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2926 | 0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0332 | 0.791 |
| 45-59 | 0.2486 | 0.086 |
| 60+ | 0.3707 | 0.018 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1905 | 0.186 |
| Asian | -0.3213 | 0.101 |
| Hispanic | 0.1156 | 0.397 |
| Other | 0.2395 | 0.373 |

Results from model assessing wildfire risk as a moderator of activity limitations on its relationship with disaster preparedness are located in Table 7.9. The results presented are for the non-randomly varying slope model, as the inclusion of the error term to the level 2 wildfire slope was non-significant (p=0.767). Mirroring the previous interaction models with activity limitations, wildfire risk was not a significant moderator (B=-0.0030, p=0.469).

**Table 7.9** Multivariable hierarchical linear regression analysis of disaster preparedness on activity limitations with wildfire risk interaction, Public Health Response to Emergent Threats Survey 2013, Healthy Places Index (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.1978 | 0.156 |
| No (reference) | -- | -- |
| Wildfire risk | 0.0095 | 0.017 |
| Presence of activity limitations * wildfire risk | | |
| Yes * wildfire risk | -0.0030 | 0.469 |
| No * wildfire risk (reference) | -- | -- |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2863 | 0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0377 | 0.742 |
| 45-59 | 0.1979 | 0.134 |
| 60+ | 0.3131 | 0.015 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.2038 | 0.209 |
| Asian | -0.3522 | 0.079 |
| Hispanic | 0.0741 | 0.560 |
| Other | 0.2907 | 0.260 |

In summary, neither perceived neighborhood social capital nor community-level social vulnerability were significant moderators of the relationship between disability and disaster preparedness. Nevertheless, social capital was directly associated with preparedness in both the self-rated health and activity limitations models, which demonstrates that all else equal, knowing

more people in one's neighborhood is associated with participation in more preparedness behaviors. Furthermore, community advantage significantly moderated the relationship between poor self-rated health and disaster preparedness such that living in a neighborhood with greater community advantage led to a less negative relationship between these focal variables. When each of the HPI domains was tested separately for interaction with self-rated health, it was determined that the housing and social participation domains were significant positive moderators, contributing to the interaction between poor self-rated health community advantage. Wildfire risk was also a significant positive moderator for the relationship between poor self-rated health and preparedness. The negative relationship between these variables was attenuated for individuals living in communities where a greater proportion of the population is at high risk for wildfires. The activity limitations measure was not significantly moderated in any of the models, suggesting that this variable did not possess a strong enough relationship with disaster preparedness to be able to detect differences in the slope across different levels of other variables. This may be a reflection of the weakness of this measure, though further interpretation will follow in the subsequent chapter.

Chapter 8. Discussion

## Summary of the Dissertation

The disaster literature provides ample evidence demonstrating that people with disabilities experience high vulnerability before, during, and after a disaster strikes. Research has highlighted how different types of functional and health limitations pose unique challenges to following evacuation orders[25,41–45] and accessing shelters and temporary housing.[41,46–48] Disasters can also lead to exacerbation of existing health problems, with a number of studies demonstrating that people with disabilities experience greater disaster-related morbidity and mortality than the general population.[26,49–52] Despite their greater susceptibility to harm, people with disabilities are less likely to report they are prepared, possess certain household disaster supplies, have a disaster or evacuation plan, or engage in preparedness trainings.[33–37,84] To better understand why they are less prepared, this dissertation aimed to elucidate the pathways that influence disaster preparedness behaviors among people with disabilities. To accomplish this overall goal, I examined 1) how having disabilities influences disaster preparedness behaviors in comparison to the general population (the focal relationship), 2) what social cognitive factors explain existing preparedness discrepancies, and 3) how these behaviors vary with community attributes. Each of the research questions were informed by existing research while addressing gaps in the current literature.

In general, the results provided evidence supporting the focal relationship (H1.1) but for only two of the four measures of disability status. Both worse self-rated health and the presence of activity limitations were significantly negatively associated with preparing for disasters. Possessing a health problem that requires the use of special medical equipment and considering yourself a person with a disability were not associated with the preparedness outcome. These

latter measures were less prevalent among the study population and also possessed weaker correlations with the disaster preparedness canonical variate.

When self-efficacy and response efficacy, two well studied correlates of disaster preparedness behaviors, were assessed as potential mediators of the focal relationship, the results yielded mixed findings. Although higher ratings of self-efficacy, perceived general response efficacy, and perceived collective response efficacy were all positively associated with the preparedness outcome (H2.2 & H3.2), only self-efficacy provided evidence of a mediating effect (H2.3). Perceived neighborhood social capital additionally did not possess a moderating effect on the focal relationship rejecting H4.1, but it was independently positively associated with preparing for disasters. While less informative of the relationship between disability and preparedness, the direct relationship between each of these social cognitive variables and the preparedness behavior outcome supports findings from past research.[20,68,87,90,123,140,141,144]

When community-level attributes were tested for moderation, both community advantage and wildfire risk possessed significant interaction terms with self-rated health. The negative relationship between poor self-rated health and disaster preparedness behaviors was weakened for individuals who lived in communities that possessed greater advantage as measured through the Healthy Places Index (H6.1). Living in a region with a greater percentage of the population at very high risk for wildfires also attenuated the negative relationship between self-rated health and preparedness among those with the poorest perceived health (H7.1). Social vulnerability, measured by the Social Vulnerability Index, was not a significant moderator of the focal relationship, rejecting H5.1.

Certain covariates were also significantly associated with preparing for disasters. Being female was associated with participation in fewer preparedness behaviors in comparison to

males. These results were significant across all of the models. Additionally, being over the age of 60 was positively associated with disaster preparedness in comparison to individuals who were ages 18-29. Race/ethnicity was not significantly associated with engaging in disaster preparedness.

Overall, the results provide mixed support for the hypotheses. While it is evident that self-rated health possessed the strongest relationship with disaster preparedness, the relationship with activity limitations was weaker and failed to yield further significant findings. When just examining self-rated health as the main independent variable, several hypotheses were supported. Worse self-rated health was negatively associated with self-efficacy, a positive correlate of preparedness, which partially mediated its relationship with this outcome. Furthermore, the lowest level of self-rated health interacted with community-level characteristics. Both community advantage and wildfire risk moderated the association between poor self-rated health and disaster preparedness so that when advantage or risk was high, the negative relationship between poor self-rated health and preparedness was weaker; conversely, when advantage or risk was low, the negative relationship between poor self-rated health and preparedness was stronger. Together the findings support the fact that both individual and community characteristics are important for getting people with health conditions prepared for disasters.

**The Focal Relationship**

Past research suggests that people with disabilities are less likely to engage in disaster preparedness behaviors. Studies that have measured disability through such variables as the presence of physical limitations, chronic medical needs, mental illness, and activity limitations, as well as measures of self-rated health and binary assessments of being disabled, have found

disability to be inversely related with self-report measures of preparing for disasters.[33–37,84] This relationship has been demonstrated for a variety of preparedness behaviors including possessing emergency supplies,[33,34] having an evacuation plan,[37] attending a CPR or first aid skills training,[35] and multi-behavior preparedness indexes.[84] Based on this prior research, it was hypothesized that each of the four measures of disability included in this dissertation would be negatively associated with the 10-item disaster preparedness index.

When the focal relationship was assessed for each of the disability measures, only two of the four models yielded significant results. This was true for both bivariate and multivariable analyses. Controlling for gender, age, race/ethnicity, and intra-community variance, both worse self-rated health and activity limitations were negatively associated with preparedness; however, the use of special medical equipment and considering yourself to be a person with a disability were not significantly associated with the preparedness outcome. One explanation for these findings is that the two non-significant measures of disability are more extreme measures of the disability construct and thus capture less of the sample population. Intuitively, being dependent on medical equipment and self-identifying as a person with a disability are more severe health limitations than more general perceptions of health or possessing activity limitations due to physical, mental, or emotional problems. Examining the descriptive statistics of the disability measures also supports this explanation. The cross tabulations of the disability measures demonstrate that the majority of people requiring the use of special medical equipment (73.1%) and considering themselves to be a person with a disability (52.1%) also possessed activity limitations, but fewer people with activity limitations also indicated yes to these other measures. This suggests that these variables are more extreme in terms of the degree of functional limitations being measured. Given that the PHRETS dataset sampled a segment of the general

population, these more extreme measures of disability were less prevalent in the study sample. For instance, only 7% of the respondents indicated that they have a health problem that requires use of special medical equipment, which is less than half the value of those who indicated that they were limited in activities (17%) or who had fair or poor self-rated health (20%). The low frequency of people requiring the use of medical equipment or considering themselves to be disabled may have therefore not provided enough statistical power to these models to detect significant effects.

Another explanation for this finding is that the two latter disability measures are weaker indicators of the disability construct. For the medical equipment question, respondents are not asked about other types of medical dependence beyond the specific types of equipment listed in the prompt (e.g. cane, wheelchair, special bed, or a special telephone). The measure may therefore neglect to capture individuals with more common chronic conditions that require medical equipment to administer medication, such as inhalers or insulin syringes. Conversely, by asking people more generally if they possess activity limitations or to rate their health does not exclude these types of conditions. To consider oneself to be a person with a disability also requires that an individual's perceptions of disability coincide with existing functional and health limitations. It is possible that people living with different types of disabilities do not consider themselves to be *disabled* as they do not possess physical impairments that are typically associated with making a social security disability claim. Alternatively, people who are out of work on a temporary disability leave may be more likely to consider themselves a person with a disability despite only possessing a temporary injury. These limitations may therefore weaken the ability to correctly measure aspects of the disability construct using these measures. This is in

contrast to self-rated health and measures of activity limitations that have been well studied throughout the public health literature.[179–182,211,212]

Results from the canonical correlation analysis additionally corroborate the mixed findings from the focal relationship models. There is a much stronger correlation between the disability canonical variate and the self-rated health (R=-0.99) and the activity limitations (-0.42) measures than with requiring the use of special medical equipment (R=-.29) or considering yourself a person with a disability (R=-.27). The disability variate correlations with individual disaster preparedness behaviors are thus most highly driven by self-rated health, followed more moderately by activity limitations. The strong predictability of self-rated health is something that has been highlighted in studies of mortality[179,180] and functional decline.[181,182] This is perhaps due to the subjective nature of the measure, which asks people to rate their health relative to their perceived social and temporal norms. For instance, research has demonstrated that older individuals often base their self-assessments of health on comparisons with age peers and that perceived health can vary with language, culture of origin, and ethnic groups.[209] This interpretation is supported by the disability cross tabulations which demonstrated differences in demographics with this measure in comparison to the others. Unlike the other disability measures which had increasing age trends, those who rated their health as fair or poor peaked at ages 45 to 59 and then slightly decreased over 60. There was also a greater proportion of respondents with fair/poor health who indicated that they speak Spanish in the home than the three other measures. The relative subjectivity of self-rated health may therefore make it a better measure of the multidimensional ways that functional and health limitations can interfere with preparedness than the other more specific disability measures that may exclude members of this population.

The results of the canonical correlation analysis also demonstrate which preparedness behaviors are driving the focal relationship. The behaviors with the highest correlations with the canonical variate was for looking for information about preparedness, attending community preparedness trainings, and having a 3-day supply of non-perishable food. The fact that the disability variables were most strongly negatively correlated with these variables suggests that these are the behaviors where there is the greatest discrepancy in participation between people living with the disabilities and the general population. Interestingly, these behaviors are based on three separate FEMA recommendations for preparedness. Looking for information about preparedness best coincides with the recommendation about staying informed about local disasters, attending community preparedness trainings best coincides with the recommendation about getting involved in community planning, and possessing a 3-day supply of non-perishable food best coincides with the recommendation about building a disaster supplies kit. FEMA strongly focuses on the importance of these different types of behaviors in their Ready campaign, which is perhaps why they are more common among members of the general population. Having access to information, planning for community disaster response, and having emergency supplies are all essential to being adequately prepared to respond to a disaster. The fact that people with disabilities are less likely to engage in these different types of preparedness behaviors highlights their greater vulnerability to the impact of disasters and furthers the goal of this dissertation to better understand why this is the case.

**Intrapersonal Mediators**

Self-efficacy, or perceptions about one's ability to effectively engage in a behavior, is a well-studied correlate of disaster preparedness behaviors. Research has demonstrated that higher levels of self-efficacy have been linked to the possession of emergency supplies, the

development of an emergency plan, one's stage of emergency preparedness, and participation in different community emergency planning efforts.[20,87,140,141] While less studied in the context of disability, studies also suggest that people with disabilities possess lower self-efficacy regarding disaster preparedness behaviors. Results from FEMA's 2011 Household Survey found that Americans who self-report as having a disability were less likely to perceive that they could respond to a diverse set of disasters and hazards (e.g. natural disaster, flood, wildfire, disease outbreak) in comparison to people without disabilities.[213] Accounts of disaster survivors with physical impairments additionally highlighted perceptions of lost confidence in the ability to actively stay safe from a disaster.[143] Based on these disability studies, as well as the well-documented relationship between self-efficacy and disaster preparedness behaviors, I hypothesized that self-efficacy mediates the relationship between disability and preparedness.

The results from the self-efficacy mediation analyses initially support this rationale. Not only was self-efficacy positively associated with disaster preparedness, but each of the four measures of disability were also negatively associated with self-efficacy. These findings support the notion that possessing varying degrees of functional and health limitations is associated with diminished confidence in the ability to prepare for disasters.

For self-rated health, including self-efficacy in the model additionally reduced the magnitude of the negative coefficient. The coefficient remained statistically significant, suggesting that partial mediation was occurring. Results from the Sobel test later confirmed that self-efficacy did in fact partially mediate the relationship between self-rated health and disaster preparedness. Respondents who perceived their health to be worse therefore possess lower self-efficacy to engage in disaster preparedness behaviors, which partially contributed to their participation in fewer of these behaviors. This finding has major implications for public health

practice as it informs one of the pathways that links disability and preparedness. Further recommendations of how self-efficacy can be utilized for disaster preparedness efforts targeting people with health conditions will be discussed later.

For the activity limitations variable, including self-efficacy in the model also reduced the magnitude of the negative coefficient to the point where it became non-significant. While this suggests that full mediation is occurring, the Sobel test, which assesses whether the mediator contributes to a statistically significant indirect effect between the independent and dependent variables, was non-significant. Introducing self-efficacy to the model therefore did not reduce enough of the variance explained by activity limitations for true mediation to be occurring. There are several possible explanations for this finding. First, the Sobel test is a conservative test, so it is possible that the model was not powered enough to see a significant effect. Given the large sample size used to conduct the mediation analysis, a more realistic interpretation is that activity limitations is a weaker measure of disability whose full effect on disaster preparedness was not strong enough to test for potential mediation. A prior validity assessment of this activity limitations measure found discrepancies between this measure and other disability variables gathered by the Social SecurityAdministration.[214] This study suggests that this measure is too broad to capture disability prevalence because it includes people with temporary conditions and those limited in any way possible. They also infer that many individuals may not view their condition as "limiting their activities" (e.g., those with intellectual disabilities or mental illness).[214] People with certain health conditions may acknowledge their difficulty in completing certain activities, but may not feel as though they are limited.[214] Assessments of the difficulty in performing specific tasks, such as those included in the Activity of Daily Living and the Instrumental Activities of Daily Living scales, may be better measures of activity limitations.

Despite the fact that neither the presence of a health problem requiring use of special medical equipment nor considering yourself a person with a disability were significantly associated with disaster preparedness, it was possible that their relationship was being suppressed, as the direct and mediated effects that were being tested had opposite signs. The mediation analysis demonstrated that self-efficacy was negatively associated with both of these variables; however, adding this variable to the models did not reveal an underlying relationship. It is therefore reemphasized that neither of these measures of disability are associated with engaging in different disaster preparedness behaviors. Self-efficacy can therefore not be mediating this non-existing relationship.

To assess whether the relationship between disability and preparing for disasters was mediated by beliefs about the effectiveness of pre-disaster preparedness, two measures of response efficacy were analyzed. The first measure assessed general perceptions of disaster preparedness efficacy by asking respondents about their level of agreement with "I don't think it really matters if you plan for disasters, such as a major earthquake." When included in each of the models, general response efficacy was positively associated with engaging in disaster preparedness behaviors. This supports theoretical models of behavior change, such as the Protection Motivation Theory, as well as past studies examining the relationship between this this social cognitive characteristic and disaster preparedness behaviors.[68,90,123,140,142,144]

FEMA's 2011 National Survey has shown that people who self-report as having a disability are less likely than the general population to believe that preparing helps across a range of natural and human-initiated disasters.[125] While the reason for this finding has not been explicitly studied, a rational explanation could be that everyday functional difficulties overshadow and undermine the efficacy of pre-disaster preparedness behaviors. For instance, if

one has a physical disability that makes it difficult to engage in common activities of daily living, such as walking, bathing, or eating, then putting aside disaster supplies or learning how to perform CPR may not feel like efficacious ways to protect against a large-scale disaster. In other words, they may incur feelings of futility amid their activity limitations, which can weaken perceptions of response efficacy.

To first assess whether people with disabilities possessed lower response efficacy in the study population, the general response efficacy measure was regressed on each of the disability variables. Two of the four models possessed significant results, with both worse self-rated health and considering yourself a person with a disability possessing negative associations with this outcome. While these findings corroborate the aforementioned rationale, the results were mixed. Neither activity limitations nor requiring the use of special medical equipment were significantly associated with general response efficacy. As previously discussed, these measures may not be the strongest representations of the disability construct; however, the fact that all four measures were strongly negatively associated with self-efficacy suggests that there may simply be a weaker association between disability and response efficacy. One possible explanation for this weaker relationship relates to the way general response efficacy was measured. Respondents were asked whether they agreed with a negatively keyed statement, which may have influenced their ability to process the question. Interpretations of negatively keyed questions have been shown to be affected by such characteristics as respondent reading skill, frustration tolerance, and idiosyncratic response styles,[215] which may have influenced how people responded. Furthermore, the question was somewhat nondescript by asking whether planning for a disaster "matters." The lack of specificity regarding the potential effectiveness of pre-disaster preparedness behaviors may have influenced the interpretation of this question. Response

efficacy is also a more distal measure of behavior than self-efficacy and its interpretation may be particularly difficult when dealing with a more abstract and rare event like a disaster. Together these factors may have increased the variability of response efficacy across respondents with disabilities.

The second response efficacy variable was oriented towards the benefits of community preparedness by asking respondents about their level of agreement with the following statement: "planning with my neighbors now won't help my household after an earthquake or other major disaster." While collective response efficacy is less studied than general response efficacy in the context of preparedness, it was hypothesized that there would be a positive relationship with preparing for disasters due to the fact that several of the behaviors included in the preparedness index were focused on disaster planning and communication with members of the community. When collective response efficacy was included in each of the models, it was in significantly positively associated with the preparedness outcome. A higher level of agreement about the efficacy of planning with neighbors was thus associated with an increase in the number of preparedness behaviors, confirming this hypothesis.

When collective response efficacy was regressed on the four disability measures, it was only significantly associated with self-rated health. Worse self-rated health therefore appears to be associated with diminished confidence in the usefulness of planning for a disaster with members of the community. The null findings for the remaining variables may be related to their weakened ability to measure the disability construct or the fact that the collective response efficacy question was also negatively keyed, which may have influenced the way different respondents processed the statement. Alternatively, it is possible that perceptions of collective response efficacy were dependent on existing neighborhood dynamics relating to how well

people know their neighbors and whether they assume a more collective culture. For example, if one lives in a community with weak social ties between neighbors, it could be hypothesized that they would not have much faith in their collective ability to successfully protect against disaster harm. To test this assumption, a chi-square test was conducted using the collective response efficacy and the neighborhood social capital variables. Results from the chi-square test were significant, with a greater proportion of people with lower social capital also possessing lower collective response efficacy scores and vice versa (Appendix E). This confirms that collective response efficacy depends on existing neighborhood connections, a measure that varied across people with disabilities. The varying degree to which people with disabilities rely more on others in their community may therefore reduce the shared variance between disability measures and collective response efficacy.

Results from the mediation analyses and subsequent Sobel tests demonstrated that neither general response efficacy nor collective response efficacy mediated the relationship between disability and preparedness. This was also true when the measures were combined into one single index of response efficacy. While the models do support the fact that one's perceptions about the efficacy of preparedness behaviors are correlated with actually engaging in those behaviors, it appears that this social cognitive factor does not explain lower preparedness among people with disabilities. There is perhaps not a strong enough association between disability and response efficacy, suggesting that other intrapersonal and environmental factors can better explain why they participate in fewer preparedness behaviors that the general public.

**Social and Environmental Moderators**

Much of the disaster preparedness research has focused on individual attributes. Demographic and social cognitive factors, such as perceptions surrounding behavior, are well-

studied correlates of personal disaster preparedness (e.g. Kohn et al. (2012), Levac et al. (2011)). Health behavior theories and frameworks additionally highlight the importance of one's community in affecting behavior change. Both social and physical features of the local environment can support or hinder health behaviors through such mechanisms as formation of social norms, access to resources, and exposure to risk. Extending this research to the disaster preparedness field is key to better understanding the multidimensional factors that influence pre-disaster preparedness among people living with disabilities.

According to Coleman's Theory of Social Capital, social relationships can provide a variety of resources that can be applied to achieve different goals.[145] Examples of social capital functions include the provision of social support, formation of social norms, and the active seeking of information (i.e. milling). Possessing more relationships within a social structure, such as one's neighborhood, can support different social capital functions that can foster preparedness behaviors. While the research examining how social capital influences disaster preparedness is mixed, there is evidence demonstrating that different aspects of one's social network are associated with increased disaster preparedness behaviors. Possessing a greater number of neighborhood connections,[87] knowing anyone who had taken preparedness actions,[140] and having members of one's network as motivation to prepare[35,107] have all been linked to preparing for disasters. Results from the self-rated health and activity limitations models that included neighborhood social capital as an individual covariate demonstrated that it was positively associated with the preparedness outcome. Knowing a greater a number of people in your neighborhood who you could turn to for a favor was thus associated with engaging in a greater number of preparedness behaviors.

Although it was hypothesized that neighborhood social capital would moderate the relationship between disability and preparedness, the results from the interaction models were non-significant. Regardless of the number of close neighborhood connections, people with disabilities possessed the same relationship with preparing for disasters. Knowing a greater number of neighbors therefore did not act as a buffer for people with disabilities, which might be due to the fact that other people, such as family members or other caretakers, play a more important role in preparing for disasters. Results from the 2011 FEMA Household Survey have demonstrated that people with disabilities are more likely to rely on members of the household (61%) than neighbors (44%) in the first 72 hours following a disaster.[213] This same relationship could plausibly be true of pre-disaster preparedness behaviors where family members play a more integral role in encouraging people with disabilities to prepare.

Both the Social Vulnerability Index and the Healthy Places Index were established as community-level indicators of social and environmental health resources. SVI was specifically developed to measure the socioeconomic and demographic factors that can affect the resilience of communities following a disaster,[18] whereas HPI contains similar indicators of community advantage but that extend to a broader definition of the social determinants of health.[161] Based on a theoretical model of social vulnerability to disasters, it was hypothesized that higher social vulnerability would exacerbate the negative relationship between disability and preparedness. Similarly, community advantage would buffer the negative effects of disability on preparing for disasters.

When social vulnerability was tested as a moderator in both the self-rated health and the presence of activity limitations models, the interaction term was not statistically significant. When treated as an individual covariate, the coefficient for SVI was also non-significant,

suggesting this may be an issue with the measure itself. SVI is a national index that ranks each indicator across all census tracts in the U.S. In comparison to census tracts in other parts of the country, the SVI rankings within Los Angeles County are more similar. HPI, on the other hand, uses a state-based ranking system. By only comparing measures across census tracts in California, the HPI measure is more sensitive to local variation, making it a better measure to evaluate the moderating effect of community advantage across communities in Los Angeles County.

When HPI was included as a moderator of self-rated health on the relationship with preparing for disasters, the model yielded significant results. For every one unit increase in community advantage, individuals with poor self-rated health participated in a mean increase of 0.0155 disaster preparedness behaviors. This significant finding was quite surprising due to the low intraclass correlation coefficient for the self-rated health model. Less than 10% of the variation was between communities, so the fact that a community-level variable could still detect a moderation effect suggests it had a strong influence on preparedness among people with poor self-rated health. This finding supports the rationale that living in a community with greater advantage provides a number of additional opportunities and resources that support preparedness.

Results from the sub-analyses using the HPI domains suggest that this moderating effect is mostly driven by the community's housing and social attributes, followed by marginal effects from economic characteristics, healthcare access, and the cleanliness of the environment. The HPI's housing domain contains measures of crowding, percent of homeowners, cost burden of housing, and higher quality housing. There are several possible reasons that could explain why the housing domain reduced the negative influence of poor health on preparedness behaviors.

First, as homeowners, people may be more invested in the security of their home and thus more likely to stockpile emergency supplies. This is supported by past research that has found that compared to renters, homeowners are more likely to stock the set of recommended emergency items[74] and prepare the household for a disaster.[216] Homeownership can also denote greater stability in the composition of neighborhood residents, which may mean they are more likely to possess prior experience with local emergencies, a strong motivator to being prepared.[107] Better quality housing and lower cost burden of housing additionally suggest better community economic conditions, which may contribute to individual financial resources to purchase and maintain disaster supplies. It may also mean greater community resources to host emergency trainings that residents can attend. People with poor health who live in communities with overall better housing conditions may therefore possess greater motivation and access to resources that can foster disaster preparedness.

The HPI's social domain is comprised of the percent of registered voters and the percent of family homes with two parents. Going beyond a community's economic characteristics, this domain captures more of the social involvement of community members, both within the household and relating to civic responsibility. There are several plausible interpretations for why the social domain mitigated the negative association between poor health and preparedness. To start, a community where more people are registered to vote signifies greater political engagement. People who want to make a difference in their communities through political means may also be more inclined to engage in community-building activities, such as attending community disaster meetings and trainings. The presence of two-parents in the home, which has historically been linked to such factors as lower rates of poverty[217,218] and greater academic achievement among children,[219–221] can also be thought of as a proxy measure for both familial

stability and support. Communities with supportive family structures may foster greater planning for disasters among members of the family. This may be particularly influential for people in poor health who may rely more on others during emergency situations. As demonstrated by the non-significant interaction term with neighborhood social capital, family members may be more important than neighbors for motivating people with disabilities to prepare.

Wildfire risk, measured as the percent of the population living in a very high wildfire risk region, was studied as a physical attribute of the community that relates to hazard exposure. Given the seasonal nature of wildfires, it was considered a potential proxy measure for prior experience with natural hazards. Southern California typically experiences wildfires during warm and dry periods in the summer (June-September), or during the fall (September-December), when they are driven by the Santa Ana winds.[222] The impact of wildfires in Southern California has increased in recent decades, with distinct areas experiencing greater risk due to such features as tree landscape, proximity to high-wind corridors, and average monthly temperature and precipitation.[222] Living in a high risk region increases potential exposure to wildfires and the associated experiences and perceptions of risk that can motivate decisions to prepare for next time.[4,126] Past studies have demonstrated that prior experience with a natural disaster can increase participation in pre-disaster preparedness behaviors.[85,122,127–130] It was therefore hypothesized that greater wildfire risk would attenuate the negative relationship between disability and preparedness due to increased motivation to prepare driven by prior experience with this hazard.

Results from the self-rated health-wildfire risk interaction model confirmed that wildfire risk was a significant moderator of the focal relationship. All else equal, for every one unit increase in wildfire risk, individuals with poor self-rated health participated in a mean increase of

0.0237 disaster preparedness behaviors. Again, the existence of a significant effect was surprising given the low intraclass correlation coefficient, which indicated that only 8.9% of the variance was between communities for the self-rated health model. Belonging to a community where a greater percentage of the population lives in a very high wildfire risk area thus had a strong mitigating effect on the negative relationship between worse self-rated health and disaster preparedness. This finding further highlights the importance of the local environment in getting people prepared for disasters.

**Demographic Characteristics and Preparedness**

Several of the demographic factors were also statistically significantly associated with preparing for disasters. In particular, female gender was negatively associated with preparedness in each of the models. This finding is consistent with past research, which has found that men are typically more prepared when it comes to personal disaster preparedness, such as having household disaster plans and supplies.[68,69,88] Interestingly, other studies have also suggested that women and men perform different preparedness behaviors, with women more involved planning for their families while men are more engaged in the technical aspects of preparedness, such as making improvements to the home.[89] The preparedness outcome used in this dissertation was measured by combining a variety of household and community-oriented preparedness behaviors into a single index. The fact that women were consistently negatively associated with the preparedness outcome suggests that they are overall less prepared for disasters across a range of preparedness behaviors. Lower preparedness among women potentially exposes them to greater disaster harm than their male counterparts.

Age was another demographic factor that was correlated with preparedness. In comparison to the youngest age group (18-29 years), those who were 60 years or older engaged

in a greater number of preparedness behaviors. This finding is generally supported by other studies that have found that older age is associated with developing emergency plans, stockpiling household emergency supplies, and being aware of hazards.[34,68,69,84,85] While some studies have found that the effect of age peaks before elderly years,[35,86] this dissertation's results dispute these findings, as there was an increasing trend with every age group. Furthermore, while the cross tabulations of age and the different disability measures demonstrated that older respondents possessed worse self-rated health and a greater proportion of the other disability variables, we see the opposite preparedness trend for age and disability. This opposing trend, coupled by the lack of multicollinearity between these variables (VIF range=1.024-1.054), suggests that there is a unique effect of age on preparing for disasters regardless of disability.

The literature examining the effects of race and ethnicity on preparedness is mixed. While some studies have found that minorities are less preparedn than non-Hispanic whites,[91,92] others have either found no significant association in multivariable models[69] or have reported that certain minority groups plan and prepare more for terrorism[93–95] and are more involved in community planning for disasters.[35,87] While the different models presented similar racial/ethnic trends, with African Americans and Latinos preparing more than, and Asians preparing less than non-Hispanic whites, none of the models yielded significant coefficients. Controlling for other demographic and social cognitive characteristics, race/ethnicity therefore does not appear to have a direct influence on preparing for disasters.

Although measures of individual socioeconomic status are well-known correlates of preparing for disasters at both the household and community level,[5,34,35,67–69,86,87] neither education nor income were included in the models due to their correlation with the community in which respondents lived. Despite not testing these variables, the HPI community advantage

measure included both an economy and an education domain. The economy domain contained community measures of the percent of the population with an income exceeding 200% of the federal poverty level, the percent of the population aged 25-64 who are employed, and the median household income. The education domain included community measures of the percent of population over age 25 with a bachelor's education or higher, the percent of 15-17 year olds enrolled in school, and the percent of 3 and 4 year olds enrolled in pre-school. As discussed earlier, the economy domain was a marginally significant moderator of the relationship between poor self-rated heath and socioeconomic advantage. Greater community economic advantage thus acts as a buffer to disability by getting people with worse health involved in more preparedness behaviors. Education, on the hand, was not a significant moderator, suggesting that it plays less of an important role at the aggregate community level. Regardless of these mixed findings, community-level advantage appears to have an important influence on individual-level preparedness behaviors.

**Limitations of the Dissertation**

There are certain limitations to this dissertation that must be acknowledged. First, there is the issue with the disability measures. As described earlier, having a health problem requiring the use of special medical equipment and considering yourself to be a person with a disability were not the strongest measures of the disability construct. While including these different measures aimed to assess different aspects of functional and health limitations, their low frequencies in the sample population, their inconsistent overlap with other measures, and their lack of significant relationships with the disaster preparedness outcome suggest that these variables did not line up with more general conceptualizations of disability. Once suppression by mediators was ruled out, they had to be dropped from further analysis. Additionally, the activity limitations measure was

also not the strongest predictor variable. Although it was significantly associated with preparing for disasters, its lack of further significant findings in other models suggest that this relationship was much weaker than with self-rated health. Self-rated health thus proved to the most robust measure of disability, suggesting that more subjective interpretation of health is a better representation of one's disability status. Other potential variables that may have been more useful to study could have been continuous measures of activity limitations, such as Activities of Daily Living and Instrumental Activities of Daily Living, or other more objective measures, including hospital charts or biomarker data. An assessment of whether respondents take regular medication could have also been useful due to the potential for exacerbation if a disaster interrupts access to medication. Because the analyses were limited to the four measures of health/disability available in the PHRETS dataset, these additional variables could not be explored.

Second, the intraclass correlation coefficients for the multilevel models were low, signifying that most of the variation was within communities and not between communities. Though deviance tests still justified the use of multilevel modeling, the low ICC affected the power needed to assess how community attributes influence preparedness among people with disabilities. Rather than consecutively building models by including past significant covariates in subsequent models, I had to conduct each of the higher level analyses separately in order conserve power. Fortunately this method proved adequate, as I was able to detect significant community-level moderation with community advantage and wildfire risk.

Third, the PHRETS dataset I used does not contain weights at the community level, as the data were not originally collected with the intention of conducting a multilevel analysis. Rather than running my analysis with unweighted data, I felt it was best to estimate community-

level weights to be able to run a multilevel model with enhanced representativeness of the population. I therefore derived community-level weights using the formula proposed by Goldstein.[196] Using these estimates may introduce bias into my parameter estimates; however, I attempted to further minimize bias by scaling the individual level weights to the size of each community from which they were sampled.[194]

Fourth, the PHRETS survey respondents were only sampled from households within the designated Los Angeles County communities, contributing to selection bias. Not only did sampling from the general population contribute to a low frequency of people with disabilities, but there was likely a systematic exclusion of people with more severe disabilities, as they are more likely to live in group quarters or assisted living environments that were not included in the sampling frame. By excluding respondents who did not live independently, the results cannot be generalizable to people with more severe intellectual and physical disabilities.

Another dissertation limitation was the fact that the datasets were cross-sectional. While it is plausible that functional and health limitations can reduce participation in disaster preparedness behaviors, all of the findings must be interpreted as association rather than causation. Although I did attempt to strengthen the causality inferences by conducting mediation analyses, I would have to conduct additional research with more causality criteria included, such as a randomized controlled trial, in order to support the causal argument between my focal variables.

Furthermore, all of the PHRETS data were collected using self-report measures. Self-report items are always a concern, as they can contribute to response bias, particularly when dealing with more abstract concepts. Self-report can cause individuals to respond inaccurately or falsely, which can be higher when working with underserved or low literacy populations.[223] This

may have influenced the way individuals responded to the disability measures, suggesting the need for more objective measures in disability research.

Finally, as with all analyses, there is the potential for omitted variable bias. Several well-studied individual-level correlates of preparedness, such as knowledge about disasters and risk perception, were not included in the PHRETS dataset and were therefore not studied. Including these variables could have potentially elucidated other pathways explaining the focal relationship beyond self-efficacy. At the community level, while several of the variables used were multi-dimensional and thus accounted for variety of community characteristics, other informative variables could have also been studied. For instance, a community-level measure of prior experience with a disaster would have been better to study than simply using a proxy measure of wildfire risk.

**Strengths of the Dissertation**

There are a number of strengths to this dissertation that should be highlighted. To start, PHRETS has a number of features that it make it a valuable source of data. PHRETS is a large dataset containing responses from 4700 people. A dataset this large provides a generous amount of statistical power and is particularly important for multilevel analysis which needs to control for additional community-level variance. PHRETS is also a recent survey from 2013 and thus provides relevant data that can be utilized to inform current disaster behaviors. The way the respondents were sampled from distinct communities in Los Angeles County also lends itself to multilevel analysis. Not only were sample communities selected based on number of cohesive community characteristics, but individual-level weights were applied to enhance the representativeness of each community. This allowed me to aggregate publically available census

tract data to the community level in order to study how community-level attributes influence individual-level behavior.

Another important strength of this dissertation is the use of standardized and validated measures. PHRETS adopted measures of self-efficacy, response efficacy, and social capital from standardized surveys including FEMA's 2009 Citizen Corps Survey and the 2008 Canadian General Social Survey. Even the disability measures, which were criticized as having weaknesses, were adapted from the Behavioral Risk Factor Surveillance System Questionnaire and the Los Angeles County Health Survey. This meant they had been studied by other researchers, which provided some of the justification for their potential weaknesses. Furthermore, the SVI and HPI measures were previously validated by their developers and other researchers by comparing them to other measures of vulnerability, such as Katrina-related deaths, economic losses following disasters, the federal poverty level, median household income, and the Intercity Hardship Index.[18,161,178] This provided evidence supporting each of the variables' ability to measure the intended construct.

The multilevel methodology used in this dissertation is also a novel contribution to the field. To date, much of the disaster preparedness research has been confined to individual-level variables when studying the demographic and social cognitive factors that influence preparedness behaviors. While there have been studies that have looked at community-level measures and their influence on disaster resilience (e.g. Leykin et al. (2013)[79]), they have not focused on the individual-environment interaction that can be studied using hierarchical linear modeling. As demonstrated from the results of this dissertation, community-level factors do affect individual preparedness behaviors. Both community-level advantage and wildfire risk moderated the relationship between disability and preparedness, suggesting the need for more

disaster preparedness research utilizing these methods to explore the influence of different community characteristics.

One final strength of the dissertation is the disaster preparedness outcome variable that was used. This index measured a diverse set of household and community preparedness behaviors that were informed by a theoretical model of community resilience.[76] These different measures include the different types of preparedness behaviors recommended by FEMA, from staying informed to participating in community disaster planning, and thus represent a more inclusive measure of preparedness than individual household behaviors that are typically studied. While using a composite index does not show which individual behaviors are driving the relationships, I was able to conduct canonical correlation analysis to explore these findings. Together these methods allow me to embrace a comprehensive conceptualization of what it means to be prepared while allowing me to isolate more important behaviors to the focal relationship.

**Implications for Public Health Research**

There are several research implications to the results of this dissertation. To start, we know from the disaster literature that people with disabilities are more vulnerable to the health consequences of disasters. One of the proposed contributors to their heightened vulnerability is lower pre-disaster preparedness. Several studies suggest that people who possess varying functional and health limitations are less likely to engage in different disaster preparedness behaviors, including possessing certain household disaster supplies, having an evacuation plan, or engaging in emergency trainings.[33–35,37,84] These behaviors are recommended by disaster response agencies to protect against the impact of disasters through such mechanisms as evacuating in a timely manner, staying informed about safety information, helping others in

need, and keeping the household self-sufficient in the days following a disaster. The research, however, is mixed with some other studies finding no evidence of a significant relationship between measures of disability and preparedness[34,108] or finding that people with health restrictions are more prepared in certain ways.[69,93] As a relationship that has not been exhaustively studied within the disaster literature, research in this area can help contribute to our understanding of why people with preexisting health problems suffer disproportionately from disasters. The results from this dissertation confirm that among the sample population of Los Angeles County residents, people who rate their health lower and who possess activity limitations from physical, mental or emotional problems participate in fewer of the recommended disaster preparedness behaviors. More general ailments and health restrictions thus appear to interfere with preparing for disasters, contributing to potentially greater vulnerability to disaster harm in ways that can be prevented. These findings support continued research that focuses on understanding what factors contribute to lower preparedness among people with disabilities.

According to the WHO's ICF, human functioning is a synthesis of biological, psychological, social, and environmental aspects of health.[156] Disability can be characterized by impairments of body functions and structures, limitations in activities, and restrictions of participation in life situations.[22] To assess how these different aspects of functional and health limitations influence preparedness, the dissertation used four separate measures of disability. The different measures were meant to capture both different conceptualizations of disability status and varying degrees of medical dependence. The results, however, demonstrated weaknesses in each of the variables except self-rated health. As previously described, this may have been related to the way the questions were worded or the fact that data were collected from members

of the general population where disabilities were a small minority. Nevertheless, these findings point to the need for additional preparedness research utilizing other standardized measures of disability. For instance, Activities of Daily Living and Instrumental Activities of Daily Living are well-studied scales of activity limitations that use a continuous measurement and can thus capture more nuanced degrees of disability than a dichotomous measure. More objective measures that do not rely on self-report, such as medical chart or biomarker data, would also be helpful for measuring chronic health conditions. These measures may be more valid than self-report variables which can be open to interpretation and may thus vary from person to person. Research using these other measures can help inform the complex relationship between disability and preparing for disasters.

Most of the existing disaster research has either measured preparedness as participating in specific behaviors, such as developing a household communication plan, or through preparedness scales and indexes that only examine some household preparedness behaviors. Not only are these measures inconsistent, but they often do not incorporate measures of community disaster planning, an important FEMA recommendation for enhancing community disaster resilience. Community preparedness behaviors, such as discussing evacuation plans with neighbors and attending community disaster meetings, can be especially valuable to people living with disabilities who may need additional assistance from others during a disaster. Research that considers both household and community preparedness behaviors is therefore a more appropriate way to study the relationship between disabilities and disaster preparedness. In this dissertation, the main outcome variable was a summative index of 10 different preparedness behaviors that were specifically chosen based on a model of community disaster resilience that emphasizes self-sufficiency and community engagement.[76] The finding that people with self-

rated health and activity limitations were holistically less prepared suggests that less participation in both household and community disaster preparedness behaviors is contributing to their vulnerability. Future research should also incorporate these different types of behaviors when studying preparedness among people with disabilities to help develop more targeted promotion efforts that address their specific barriers and incentives to engaging in these varied behaviors.

Research examining the pathways that explain why people with disabilities are less prepared is currently lacking. As noted by Eisenman et al. whose study examined the relationship between different measures of health status and disaster preparedness in Los Angeles County, "future research [needs to] focus on understanding why these disparities exist by identifying the factors that explain the differences in behavior. Lower levels of preparedness among ill people in this study should be investigated further to understand the motivators and facilitators of preparedness in these groups."[34] To address this current gap in the literature, I conducted mediation analyses with measures of self-efficacy and response efficacy, two social cognitive factors that have previously been shown to be correlated with preparing for disasters. This dissertation's finding that self-efficacy partially mediated the relationship between self-rated health and preparedness contributes to the literature by specifying one of the psychological reasons explaining why poor health interferes with preparing for disasters. This finding can be used to inform future studies of this relationship and suggests the need to evaluate how to best influence perceptions surrounding the ability to adequately prepare for disasters among people living with restrictive health conditions. The null findings for the outcome efficacy measures also indicate that perceptions of the effectiveness of preparing for a disaster are less important motivators to getting people with disabilities prepared. Future research should therefore focus

less on outcome efficacy and study other potential pathways informed by past research, such as knowledge about disasters, risk perception, and prior disaster experience.

To date, much of the disaster preparedness research has focused on individual characteristics such as demographics and social cognitive factors. While more researchers have started to focus on community attributes in the study of building disaster resilient communities, few have examined how both individual and community factors influence preparedness among vulnerable segments of the population. By using a multilevel approach, this dissertation both addresses this gap while highlighting the importance of the local environment in getting people prepared. The community advantage moderation model suggests that housing characteristics and social engagement are protective and should thus be further studied to understand how to utilize these factors to enhance preparedness among people living with disabilities. The same is true of wildfire risk, which is particularly important given the greater need for at-risk communities to protect their more vulnerable members and the increasing death toll from wildfires in California. Future research should examine what factors related to living in a wildfire risk area influence preparedness (e.g. prior experience, perceived risk). It would also be interesting to explore how other measures of physical risk to disasters, such as living in a flood zone or underneath a major fault line, affect individual preparedness behaviors. The results from this dissertation emphasize the need to continue studying different community characteristics in disaster preparedness research.

**Implications for Public Health Policy and Practice**

This dissertation focuses on a timely and crucial public health topic that can help advance efforts to prevent disaster-related morbidity and mortality. Not only are disasters increasing in scale and frequency, but research suggests that emergency management agencies are not

prepared to address the diverse needs of people with disabilities. In a study that surveyed emergency managers of 30 local emergency management agencies across the U.S., only 27% completed federal training on the needs of people with disabilities.[53] The majority of the emergency managers also did not know how many persons with mobility impairments live in their jurisdiction and the agencies possessed little to no representation of persons with mobility impairments at the planning or revision stages of the emergency plan.[53] Even five years after the shortcomings of Hurricane Katrina, a study of FEMA's disaster housing policy found that the agency is still inadequately prepared to meet the needs of people with disabilities.[48] More recently, a court case found that New York had failed to adequately prepare for people with disabilities before Superstorm Sandy.[224] Other studies from past disasters have additionally revealed that access to and availability of prescription medications do not meet the needs of evacuees with chronic health conditions.[54–56] These deficiencies, coupled with lower preparedness among people with disabilities, drive the need for better research-driven policy and programs in this area.

International policy documents guiding the future of disaster preparedness and response, such as the Sendai Framework for Disaster Risk Reduction, emphasize the need to include and prioritize people with disabilities in disaster planning efforts.[38–40] The Sendai framework prioritizes the development of risk reduction practices that are more accessible to people with disabilities and calls for research to incorporate disability data in order to inform inclusive planning procedures.[40] This dissertation can therefore be used to better inform these strategies as they relate to pre-disaster preparedness. By providing information on the social cognitive and environmental pathways that influence preparedness among people with disabilities, the results

can better inform targeted approaches that promote and facilitate participation in disaster preparedness behaviors.

This dissertation stresses that we must redefine our conceptualization of disability to understand how health influences disaster preparedness. Disability should not be limited to a binary concept that is traditionally linked to physical handicaps, such as being deaf, blind, or requiring the use of a wheelchair. We must redefine the term to include the various ways that health can interfere with daily functioning and access. With an ever increasing older adult population, more people are suffering from chronic health conditions that can influence their vulnerability to disasters. The results of this dissertation also suggest that people who perceive themselves to have less than optimal health are less prepared, which can further place them at heightened risk to the impact of disasters. For example, individuals who take regular medication need to be able to access these treatments during sudden disaster evacuations and could thus benefit from pre-disaster plans to stockpiles their medicine. To better reach and influence behavior among people that fall within this broader conceptualization of disability, it is perhaps best to target older adults who are more likely to experience chronic health conditions. For instance, promotional disaster planning initiatives could target Medicare recipients in hospitals, as well as people living independently in communities who utilize home healthcare services. By broadening the scope of who we consider to have disabilities, we can reach a larger segment of the population who could benefit from plans, skills and resources that can support safe disaster response and recovery.

The findings of this dissertation highlight that both individual and community factors are essential to influencing disaster preparedness among people with disabilities. Policy and programming should therefore be twofold, both targeting more proximal cognitive precursors to

preparedness behaviors and also addressing upstream factors related to community advantage that can create opportunities to support behavior change while bolstering overall social determinants of health. In terms of the individual social cognitive characteristics, the results demonstrate that lower self-efficacy acts as an inhibiting factor to getting people with disabilities prepared. Preparedness programming should therefore target this intermediary to influence behavior change. For instance, educational programs targeting people with disabilities should adapt theory-informed best practices for strengthening self-efficacy, such as social modeling and verbal persuasion.[225] Disaster preparedness communications, such as messages disseminated via mass communication channels or more locally in settings where people with disabilities may frequent, such as pamphlets and posters distributed at hospitals or nursing homes, should also use language that fosters perceptions of self-efficacy among recipients. With a whole literature that focuses on building self-efficacy across different public health disciplines, there are a number of opportunities to translate these findings to the field of disaster preparedness and response.

The results also emphasize the importance of community in influencing preparedness behaviors. Community advantage helped mitigate the negative influence of poor health on preparing for disasters, suggesting the need to invest more in strengthening overall communities, particularly in the areas of housing and the social environment. In recent years, both government and nongovernment agencies have started implementing community resilience programs that aim to improve a community's ability to protect against, mitigate, respond to, and recover from diverse threats and hazards. For instance, the Rockefeller Foundation's 100 Resilient Cities program partners with cities across the globe to support their development of different resilience-building strategies. In Los Angeles, these strategies have expanded beyond individual preparedness to focus on enhancing the built infrastructure, community connectedness, and

interdisciplinary partnerships.[226] The results from this dissertation support several of the goals that were developed by Los Angeles through the 100 Resilient Cities program, including the building of affordable housing and the strengthening of civic engagement through community collaborations.[226] Communities could strengthen housing by such actions as increasing production and preservation of affordable housing, promoting and expanding housing for vulnerable populations, and developing neighborhood-based post-disaster housing plans.[226] Civic engagement could be promoted through neighborhood outreach and education about local risks, partnerships between community organizations and local experts and resources, and the promotion of neighborhood disaster planning programs.[226] Continued investment in communities not only provides people with disabilities with the additional resources needed to improve preparedness behaviors, but it can help build communities that are resilient to the impact of disasters.

One strategy for strengthening community engagement in disaster planning is through partnerships between community-based organizations and local health and emergency management agencies for more targeted preparedness efforts. Research supports that community and faith-based organizations can help expand the reach of local health departments to marginalized groups that face greater risks during emergency events.[227] Through their insider knowledge of community cultures, dynamics and resources, community-based organizations can help spread the message of local health departments to both people living with disabilities as well as their caretakers.[228] Community-based organizations could also benefit from these partnership through enhanced support and resources. Studies of community organizations that cater to people with disabilities, such as nursing homes, home-based primary care providers, and community-based organizations that serve the deaf or hearing impaired, suggest that they lack

the necessary plans and support to meet the emergency needs of their vulnerable constituents.[45,57–59] By working with these organizations, as well as more far-reaching establishments such as faith-based organizations, local health departments can help with their preparedness planning by providing communication materials, trainings, and technical support throughout the development of emergency programs and plans. Neighborhoods with worse housing conditions and less social engagement, where people with disabilities are less prepared, could particularly benefit from these additional resources. Partnerships between government and community organizations can therefore strengthen both of their abilities to address the specific preparedness needs of people with disabilities.

Although I am recommending that preparedness efforts should focus on both the proximal social cognitive precursors to behavior and the distal community characteristics that provide resources and opportunities to prepare for disasters, I recognize that we live in a limited resource environment. Prioritizing where funding should be allocated relies on the comparative effectiveness of each of these types of approaches. As demonstrated from self-efficacy's strong mediation effect, investing in programs that foster self-efficacy can have a strong direct impact on preparedness behaviors among people with poor health. Policies addressing upstream facilitators of community advantage possess a relatively weaker direct influence on preparing for disasters; however, they also have the potential to address the social determinants of health that influence disaster vulnerability. We know from the literature that individuals with disabilities are more likely to possess overlapping demographic and social factors that place them at greater risk during a disaster, including poor housing conditions, lower employment and income rates, undiversified sources of income, and societal stigmatization.[26,27] Studies of self-rated health also demonstrate that racial minorities, individuals with lower socioeconomic status, and people who

live in areas with greater income inequality are more like to rate their health as poor.[229,230] The demographics of the PHRETS respondents who rated their health as poor further supports this notion, as they possessed lower levels of income and education and were also more likely to be older, a racial/ethnic minority, and speak Spanish in the home. Place-based approaches that strengthen the economic and social conditions of communities have been shown to reduce health disparities across different health outcomes[231,232] and can thus help target these members of the population who are more socially vulnerable to the impact of disasters. Changing health behaviors, such as those related to disaster preparedness, is also most effective when paired with broader changes to the environment that support the behavior through the provision of resources and social support.[233] Investing in housing and community planning initiatives that promote civic engagement therefore appears to have the greatest potential to strengthening disaster resilience among people with poor health, as it both supports preparedness behaviors while addressing the some of the social conditions that make people with disabilities more vulnerable to disasters.

**Conclusion**

People living with disabilities are more vulnerable to the impact of disasters yet participate in fewer preparedness behaviors. This dissertation aimed to build on our understanding of 1) how different measures of functional and health limitations influence preparing for disasters, 2) what social cognitive factors explain lower preparedness among these individuals, and 3) how these behaviors vary with community attributes. The results contribute to the literature by highlighting how people with worse self-rated health and activity limitations participate in fewer of the recommended preparedness behaviors than the general population. In particular, self-rated health was the strongest predictor of preparedness, demonstrating the strength of this variable's ability to detect differences in the different types of preparedness

behaviors, most notably looking for information about getting prepared, having a 3-day supply of non-perishable food, and attending a training to help community members during a disaster. Lower self-efficacy is one of the pathways that partially explains this finding and should be utilized in future efforts that aim to enhance preparedness among populations with disabilities and other health conditions.

Using a multilevel approach, the results also highlight the importance of community attributes in mitigating the negative influence of poor health on preparedness. Living in a community with a high risk for wildfires was protective for residents with poor self-rated health, suggesting that they have greater awareness and experience with disasters which motivates their preparedness behaviors differently than low-risk communities. Living in a more advantaged community, particularly with better quality housing and social involvement, also diminishes the negative association between poor health and preparing for disasters. To address these community characteristics, emergency planning efforts should allocate resources to building healthy communities that are more resilient to disasters. Local health departments and emergency management agencies should partner with community-based organizations to enhance preparedness efforts that target these vulnerable residents. Together these findings support inclusive disaster planning efforts that focus on getting people with disabilities better prepared for disasters as the first line of defense of protecting against their harmful impact. Future research in this area should focus on identifying other pathways linking disability and preparedness and how to best utilize community resources to enhance preparedness among these more vulnerable members of the population.

Appendices

## Appendix A

**Figure A.1** Distribution and Normal Probability (QQ) Plot for Disaster Preparedness vs. Self-Rated Health

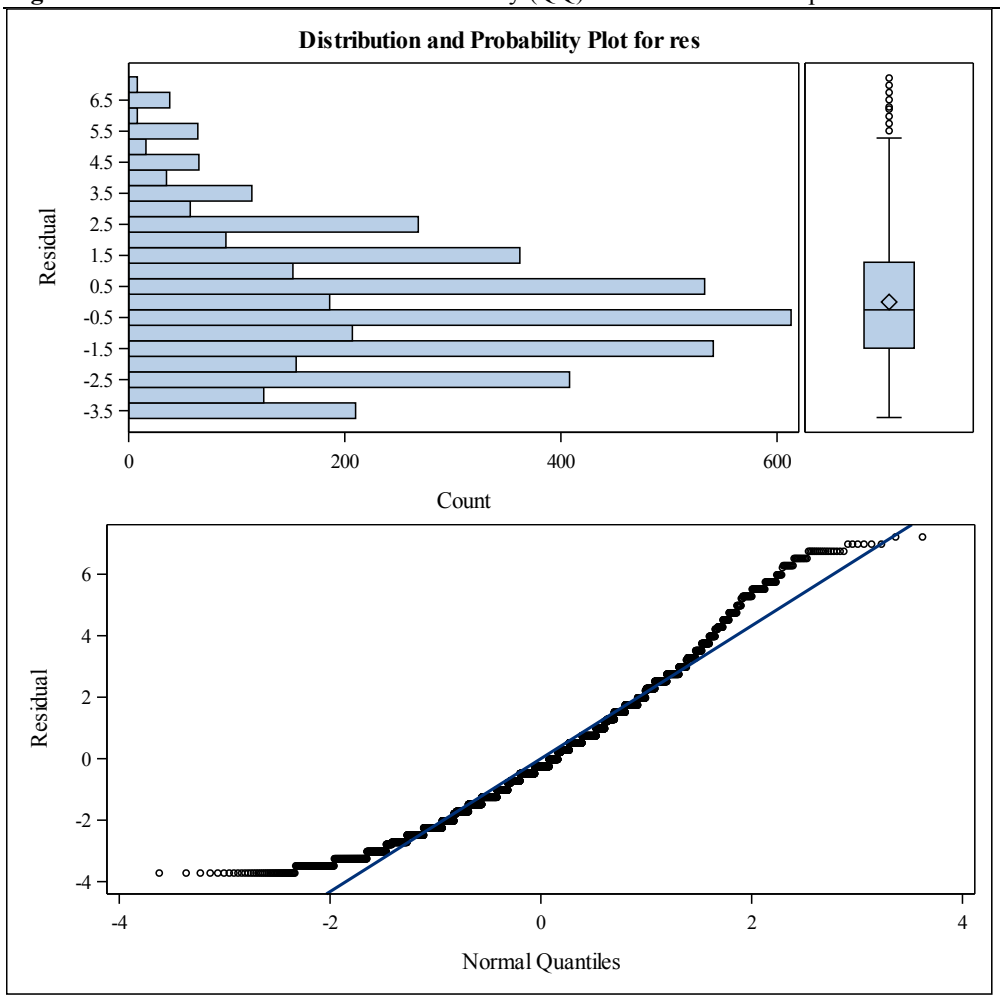


**Figure A.2** Distribution and Normal Probability (QQ) Plot for Disaster Preparedness vs. . Having Health Problem that Limits Activities

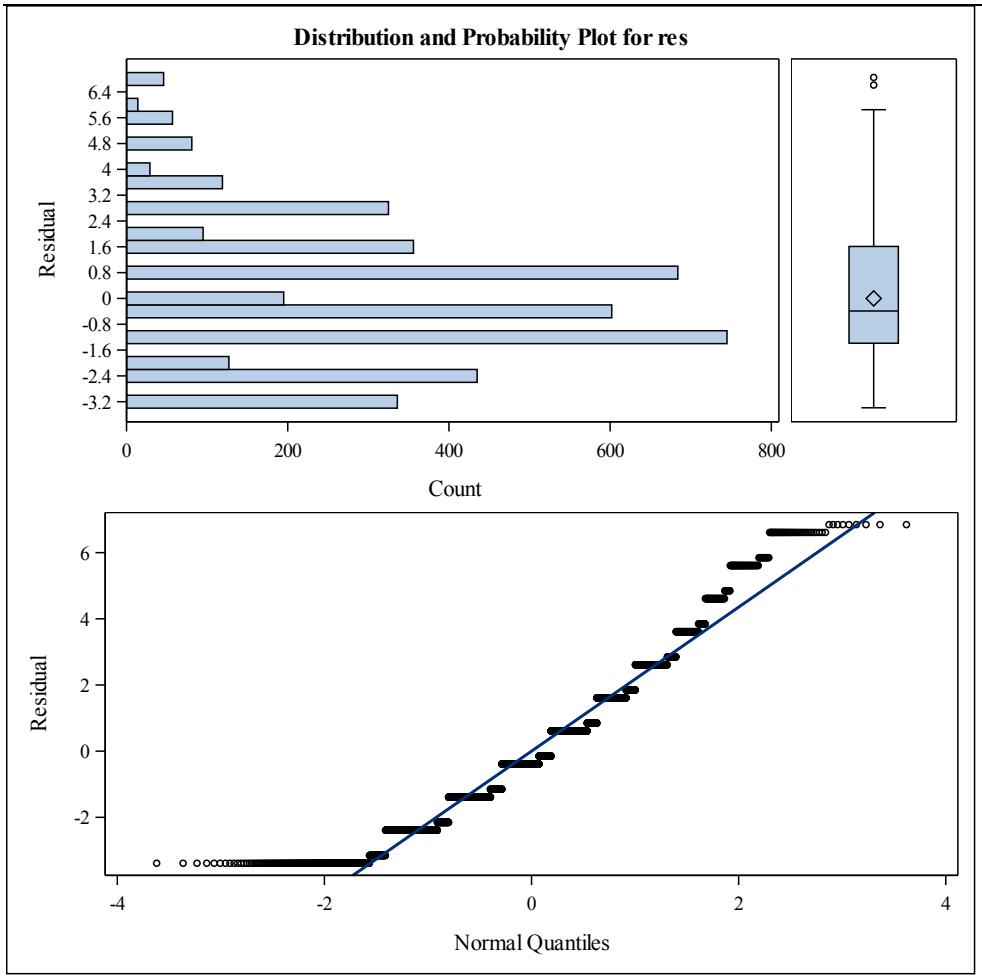


**Figure A.3** Distribution and Normal Probability (QQ) Plot for Disaster Preparedness vs. Having Health Problems that Require Special Equipment

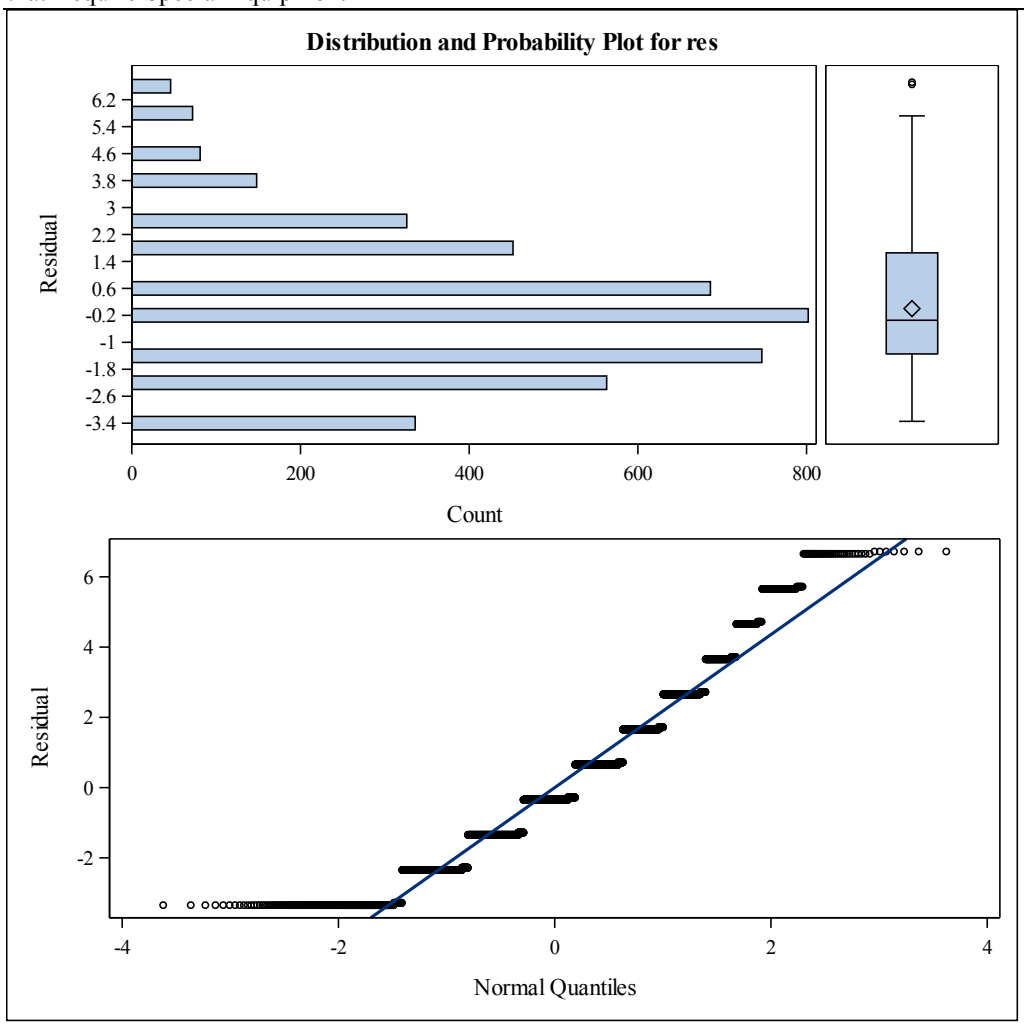
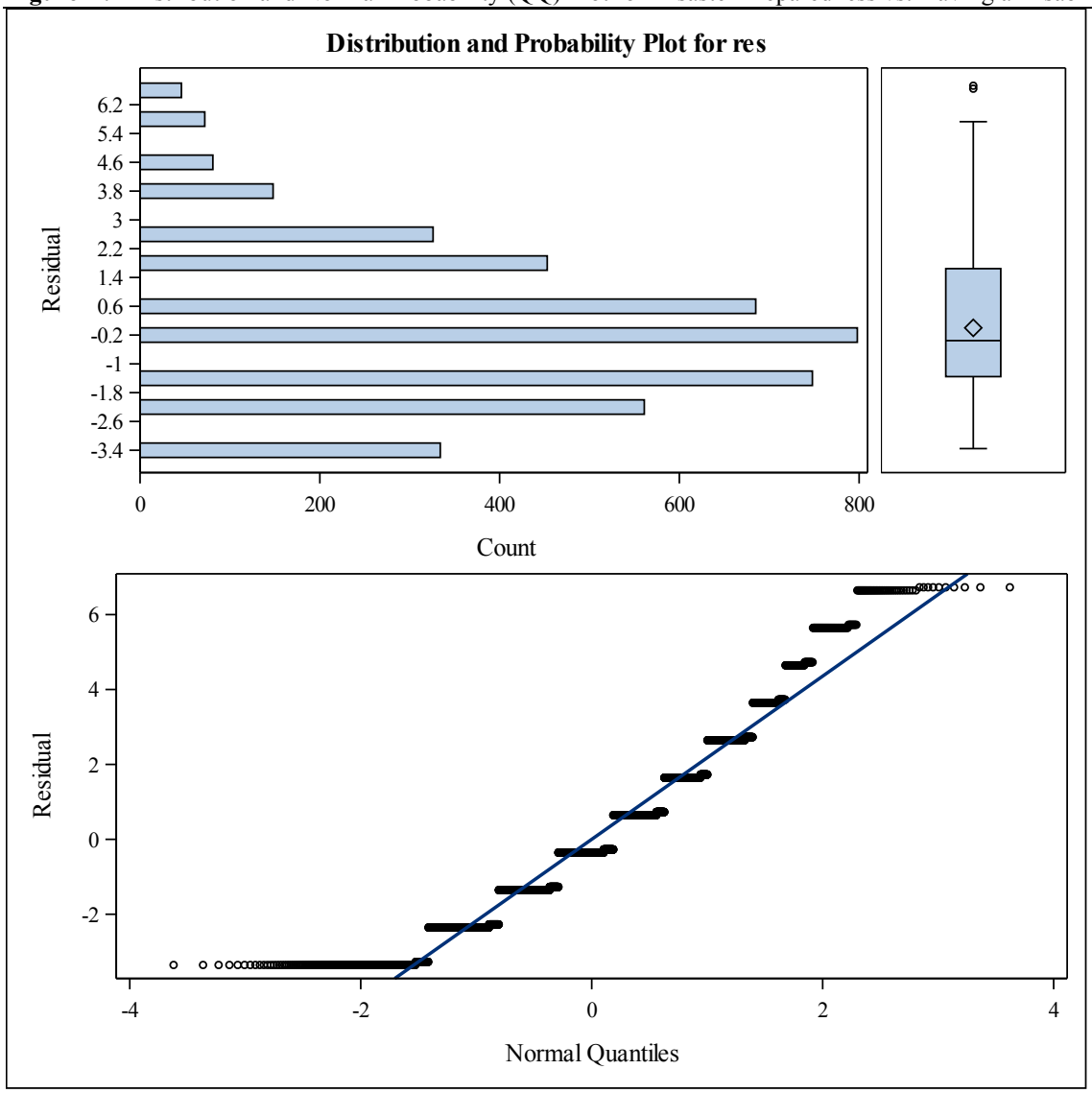


**Figure A.4** Distribution and Normal Probability (QQ) Plot for Disaster Preparedness vs. Having a Disability



## Appendix B

**Figure B.1.** Residual vs. Predicted Plot for the Disaster Preparedness vs. Self-Rated Health Model

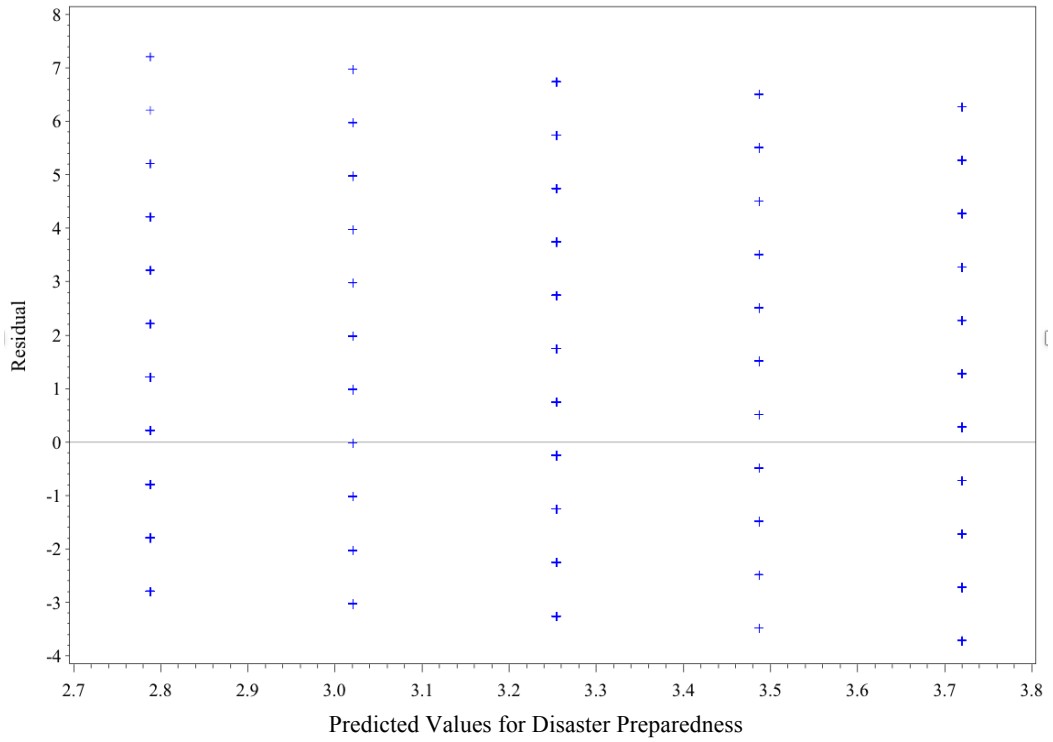



**Figure B.2** Residual vs. Predicted Plot for the Disaster Preparedness vs. Having Health Problem that Limits Activities

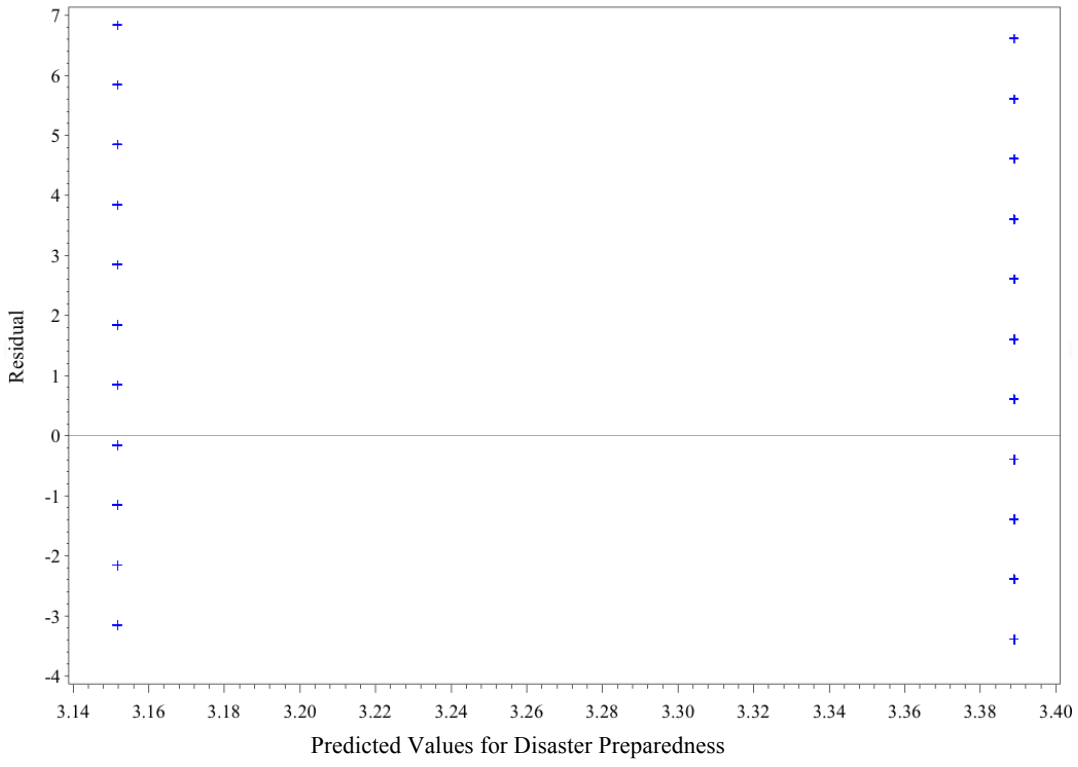


**Figure B.3** Residual vs. Predicted Plot for the Disaster Preparedness vs. Having Health Problems that Require Special Equipment

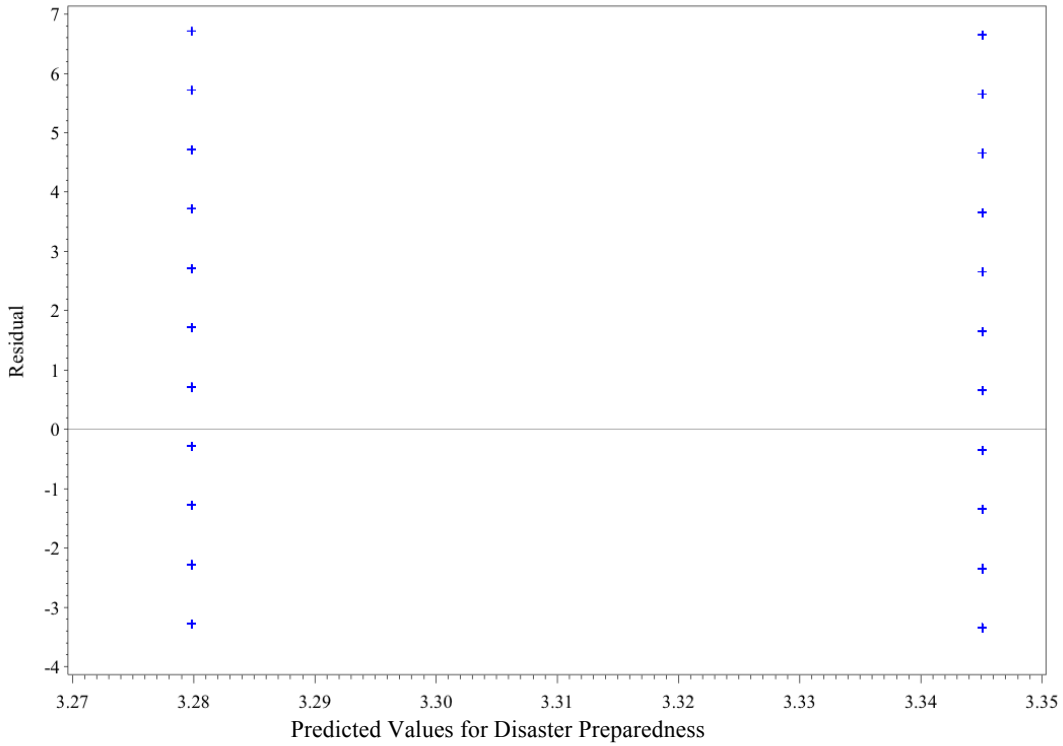
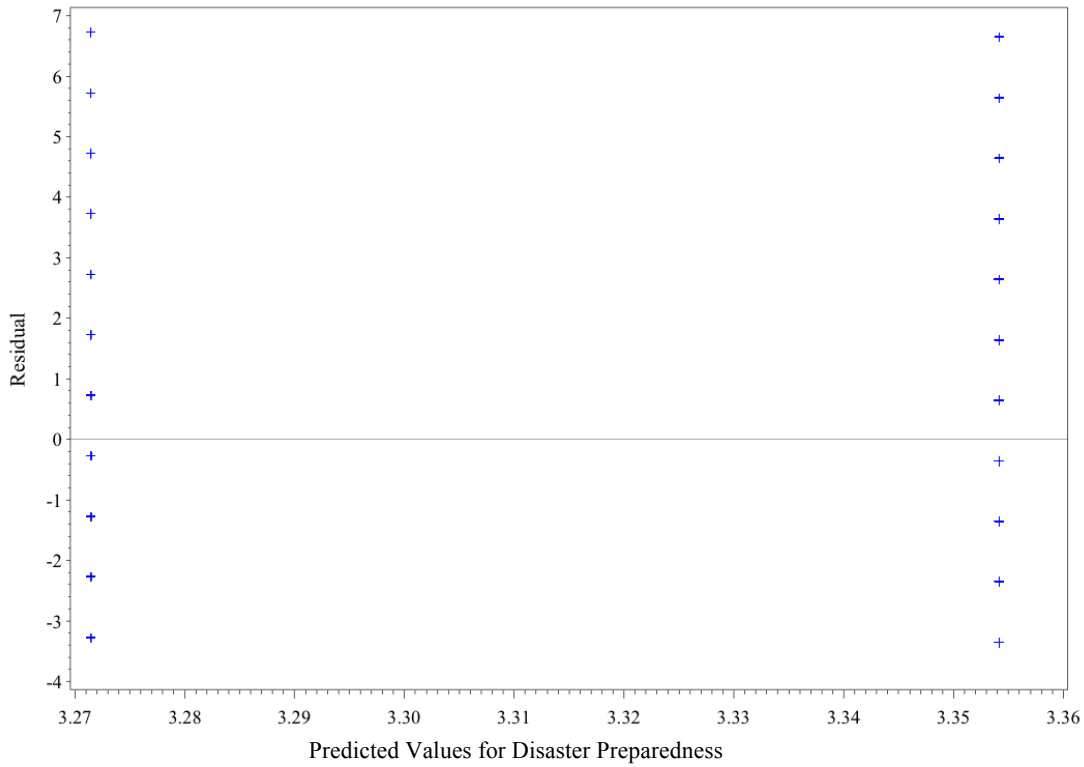



**Figure B.4** Residual vs. Predicted Plot for the Disaster Preparedness vs. Having a Disability



**Appendix C**

**Table C.1** Multivariable hierarchical linear regression analysis of self-rated health on disaster preparedness with social capital as individual covariate (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.5376 | 0.007 |
| Fair | -0.5314 | <0.001 |
| Good | 0.3497 | 0.007 |
| Very good | -0.0401 | 0.619 |
| Excellent (reference) | -- | -- |
| Social capital | 0.6257 | <0.001 |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2275 | 0.010 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.1283 | 0.328 |
| 45-59 | 0.2703 | 0.054 |
| 60+ | 0.3983 | 0.012 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.2303 | 0.100 |
| Asian | -0.2968 | 0.178 |
| Hispanic | 0.0935 | 0.434 |
| Other | 0.2687 | 0.321 |

**Table C.2** Multivariable hierarchical linear regression analysis of activity limitations on disaster preparedness with social capital as individual covariate (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.1967 | 0.037 |
| No (reference) | -- | -- |
| Social capital | 0.6395 | <0.001 |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2264 | 0.009 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.1299 | 0.302 |
| 45-59 | 0.2378 | 0.076 |
| 60+ | 0.3676 | 0.009 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.2137 | 0.164 |
| Asian | -0.3177 | 0.174 |
| Hispanic | 0.0433 | 0.687 |
| Other | 0.2942 | 0.271 |

**Appendix D**

**Table D.1** Multivariable hierarchical linear regression analysis of self-rated health on disaster preparedness with social vulnerability as individual covariate (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Self-rated health | | |
| Poor | -0.7655 | <0.001 |
| Fair | -0.6930 | <0.001 |
| Good | 0.4280 | 0.002 |
| Very good | -0.0947 | 0.307 |
| Excellent (reference) | -- | -- |
| Social vulnerability | 0.0003 | 0.943 |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2862 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0391 | 0.749 |
| 45-59 | 0.2551 | 0.076 |
| 60+ | 0.3736 | 0.015 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1628 | 0.261 |
| Asian | -0.3394 | 0.090 |
| Hispanic | 0.0903 | 0.506 |
| Other | 0.2671 | 0.301 |

**Table D.2** Multivariable hierarchical linear regression analysis of activity limitations on disaster preparedness with social vulnerability as individual covariate (n=4700)

| **Independent variable** | **Standardized beta coefficient** | **p value** |
|---|---|---|
| Presence of activity limitations | | |
| Yes | -0.2275 | 0.037 |
| No (reference) | -- | -- |
| Social vulnerability | -0.0025 | 0.534 |
| Gender | | |
| Male (reference) | -- | -- |
| Female | -0.2896 | <0.001 |
| Age | | |
| 18-29 (reference) | -- | -- |
| 30-44 | 0.0322 | 0.773 |
| 45-59 | 0.2017 | 0.126 |
| 60+ | 0.3119 | 0.014 |
| Race/ethnicity | | |
| White (reference) | -- | -- |
| African American | 0.1648 | 0.293 |
| Asian | -0.3733 | 0.070 |
| Hispanic | 0.0474 | 0.731 |
| Other | 0.2863 | 0.261 |

## Appendix E.

**Table E.1** Cross tabulation of collective response efficacy with neighborhood social capital after weighting, Public Health Response to Emergent Threats *Survey* 2013 (n=4700)

| | **About how many people in your neighborhood do you know well enough to ask for a favor?** | | | |
|---|---|---|---|---|
| Collective Response Efficacy | None n (%) | 1-5 n (%) | 6-10 n (%) | Over 10 n (%) |
| 1 | 8 (3.5) | 82 (3.0) | 17 (2.03) | 34 (4.4) |
| 2 | 81 (35.9) | 559 (20.6) | 128 (15.1) | 136 (17.7) |
| 3 | 113 (50.4) | 1581 (58.1) | 498 (58.8) | 385 (49.9) |
| 4 | 23 (10.2) | 499 (18.3) | 204 (24.0) | 215 (28.0) |
| Total | 225 (100) | 2722 (100) | 847 (100) | 770 (100) |

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